WHAT PRICE COMMITTMENT - WHAT BENEFIT? THE COST OF A SAVED LIFE IN A DEVELOPING LEVEL I TRAUMA CENTER

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Background: In 1999, a Level I Trauma Center (TC) committed significant resources for development, recruitment of trauma surgeons and call pay for subspecialists. While this approach has sparked a national ethical debate, little has been published investigating efficacy. This study examines the price of commitment and outcomes at a TC. **Methods:** Direct costs (DC) including salary, call pay and personnel expenses, were analyzed against outcomes for two periods defined as PRE (1994-1999) and POST (2000-2005). All patient care costs and 1999-2000 transition data were excluded. Demographics, outcomes and DC were compared. Significant mortality reductions stratified by age and Injury Severity Score (ISS) were used to calculate lives saved in relation to DC. Student's t and Chi-square were used. **Results:** DC increased $14.5 million or $83.8 thousand per life saved.

Table 1. - Demographics, Outcomes and Direct Costs (*p ≤ 0.05)

Demographics	**PRE (n = 7,587)**	**POST (n = 11,059)**
Age (years)	41.4 +/- 24.4	41.3 +/- 24.4
ISS Mean	10.5 +/- 9.7	11.6 +/- 10.1*
Revised Trauma Score	10.8 +/- 2.8	10.7 +/- 2.8*
Average LOS (days)	6.8 +/- 8.8	6.5 +/- 9.8*
Mortality ISS ≥ 16 (%)	23%	17%*
Direct Costs (millions)	$7.6	$22.1*

Table 2. - Percent Mortality Change (POST minus PRE) & Saved Lives Calculation

Age	**% Change Mortality (# Lives Saved)**			**Total**
(years)	ISS 1 – 15	ISS 16 – 25	ISS 26 – 75	**Lives Saved**
≤ 18	1.0* (13)	4.7* (10)	12.6* (20)	43
19 – 54	-0.1 (-4)	6.2* (65)	9.6* (65)	130
≥ 55	0.0 (0)	6.1‡ (34)	-1.9 (-4)	0
*PRE vs. POST mortality p≤ 0.05, ‡p=0.06				173

If p=0.06 group is included, saves increase to 207, cost/life decreases to $70 thousand.

Conclusions: Resources for program development including salary and call pay, significantly reduced mortality in injured patients. Price of commitment: $2.9 million/year. Cost of a saved life: $84 thousand. Benefit: 173 surviving patients who would otherwise be dead. True benefit: only the survivors and their families really know.

692 REQUESTS FOR TRANSFER TO A LEVEL I TRAUMA CENTER: IMPLICATIONS OF THE EMERGENCY MEDICAL TREATMENT AND ACTIVE LABOR ACT (EMTALA)

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INTRODUCTION: EMTALA effectively require Level I trauma centers (TC) to accept transfers for a higher level of care if capacity exists. We hypothesized that EMTALA would burden a level I TC by selective referral of a poor payer mix of primarily non-operative patients. **METHODS:** All transfers calls (12/03-9/05) to our level I TC are handled by a dedicated transfer center. Calls were reviewed for age, surgical service requested, and outcome of request. The trauma registry was queried to compare ISS, hospital LOS, operations, mortality and payer status for transfer and 1º catchment patients. **RESULTS:** 821 calls were received. 77 calls were cancelled by the referring hospital and 52 were for consult. Of the 692 transfer requests, 534 (77%) were accepted, 134 (19%) denied for no capacity and only 24 (4%) were declined by TC as not clinically indicated.

	Transfers	1º Catchment	P-value
Age	32.0±1.49	38.9±0.51	<0.001
ISS	13.6±0.62	13.7±0.26	0.892
LOS	7.0±0.70	7.4±0.25	0.583
Mortality	11.8%	4.1%	<0.001
Operations	58%	51%	0.04
Insurance	49%	53%	0.476
Medicare/aid	30%	24%	0.091
Unsponsored	21%	23%	0.6

Although trauma (24%) and neurosurgery (24%) were the most commonly requested services followed by orthopedics (20%), orthopedics accounted for 60% of operations on transferred patients compared to 10-13% for trauma and neurosurgery (mostly spine). **CONCLUSIONS:** Contrary to our assumptions, EMTALA patients had an identical payer mix and increased operative need compared with our 1º catchment patients. They do represent a large additional patient load (20-25% of admissions) and differentially impact specialists; mostly operative for orthopedics and complex, non-operative care for trauma and neurosurgery. These data suggest that the primary motivations for transfer are specialist availability and complexity of care rather than financial concerns. As we providing back-up specialty call coverage for a wide geographic area, this further supports the need for trauma systems development.

The Delaware Trauma System: Impact Of Level III Trauma Centers

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Introduction: In January, 2000, Delaware instituted a statewide trauma system which included establishing Level III trauma centers in counties previously without trauma centers. A five-year analysis was undertaken to assess the impact of the system.

Methods: Using the state trauma registry, trauma admissions to Delaware's acute care hospitals from 1995 to 2004 were identified and categorized into pre-implementation (1995-99) and post-implementation (2000-04) groups. These groups were compared in aggregate and by individual counties for differences in mortality rate, mean ISS, and transfers out. Statistical analysis was performed using chi square test with p ? 0.05.

Results:

State of Delaware				
Year	**n**	**Mortality**	**Mean ISS**	**Transfers out**
1995-99	13,436	4.18% (562)	9.2	7.11% (1,028)
2000-04	19,012	3.82% (727)	9.3	8.46% (1,758)
New Castle County (Level I Trauma Center)				
Year	**n**	**Mortality**	**Mean ISS**	**Transfers out**
1995-99	10,591	3.89% (412)	9.5	6.47% (733)
2000-04	13,764	4.20% (578)	10.3	6.05% (887)
Kent & Sussex Counties (Level III Trauma Centers)				
Year	**n**	**Mortality***	**Mean ISS**	**Transfers out ***
1995-99	2,845	5.27% (150)	8.2	7.66% (295)
2000-04	5,248	**2.84% (149)**	**6.4**	**13.67% (871)**

*** p ? 0.05**

Conclusion: Implementation of a state trauma system that includes level III trauma centers has decreased trauma-related mortality rates in the counties served by these centers. In the county served by the level I trauma center, the rate of mortality remained unchanged despite the increase in size of this center's catchment area. These findings appear associated with the transfer of high acuity trauma patients from Level III to Level I trauma center while continuing to provide service to lower acuity patients at these centers.

CHANGING THE CULTURE AROUND END OF LIFE CARE IN THE TRAUMA ICU: REPORT OF THE ROBERT WOOD JOHNSON FOUNDATION DEMONSTRATION PROJECT ON PALLIATIVE CARE IN THE TRAUMA INTENSIVE CARE UNIT (TICU)

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Purpose: 10-20% of trauma patients admitted to the Trauma ICU (TICU) will die from their injuries. Providing appropriate end of life care in this setting is difficult and often late in the patient's course. Patients are young, prognosis uncertain, and conflict common around goals of care. We hypothesized that *early, structured* communication in the TICU would improve end of life care practice and decision making.

Methods: A prospective, observational study on consecutive trauma patients admitted to the TICU before (3/03-3/04) and after (3/04-3/05) a structured communication intervention was integrated into TICU care. The program included: Part I, early (on admission) family bereavement support, assessment of prognosis, and patient preferences and Part II (within 72 hours) structured family/physician meeting about goals of care. Data on goals of care discussions, do-not-resuscitate orders (DNR) and withdrawal of life support (W/D) were collected from physician rounds, family meetings, and medical records.

Results: 84% TICU patients received Part I Intervention and 65% received both Part I and Part II Intervention. Discussion of goals of care by physicians on rounds increased from 4% to 36% of patient-days. During intervention period rates of mortality and W/D were unchanged, but DNR orders and W/D were instituted earlier in hospital course. Both TICU and hospital LOS were decreased in patients who died (see Table).

Trauma ICU Admissions	Dead	Mort. Rate	ICU LOS	Hosp LOS	DNR	W/D	Admit to DNR	Admit to W/D
Baseline n=289	45	16%	9.5	20.2	44%	39%	23 days	8.1days
Intervtn n=375	59	16%	6.7	16.1	68%	39%	7 days	7.3days

Conclusions: Structured communication between physicians and families resulted in earlier consensus around goals of care for dying trauma patients. Integration of early communication alongside ongoing aggressive trauma care can be accomplished without change in mortality and has the ability to change the culture of care in the trauma ICU.

PRACTICE PATTERNS AND OUTCOMES OF RETRIEVABLE VENA CAVA FILTERS IN TRAUMA PATIENTS: A AAST MULTI-CENTER STUDY

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Purpose: To compare practice patterns and outcomes of post-traumatic retrievable vena caval filters (R-IVCF). Methods: A retrospective review of R-IVCFs placed during 2004 at 21 participating centers with minimum 6-month follow up. Primary outcomes included major complications (migration, PE, symptomatic caval occlusion) and reasons for failure to retrieve. Results: 446 patients (69% male, 92% blunt trauma) were treated with filters, 76% for prophylactic indications. 79% were placed by interventional radiology. Excluding 33 deaths, 152 were Gunter-Tulip (GT), 224 Recovery (R), and 37 Optease (Opt). Placement occurred 6±8 days after admission and retrieval at 50±61 days. 51% had followed up after discharge (5.7±4.3 months) .Only 22%of R-IVCFs were retrieved.

Attempts made	G-T (54)	R (50)	Opt (11)
Technically Unable	5 (10%)	7 (14%)	3 (27%)
Residual Thrombus	3 (6%)	2 (4%)	5 (46%)

The primary reason filters were not removed was due to loss to follow up (31%). The likelihood that loss to follow up led to failure to retrieve increased 4-fold (8% to 44%, p=0.001) when the service placing the R-IVCF was not directly responsible for follow up. Complications did not correlate with mechanism, injury severity, service placing filter, trauma volume, anticoagulation use, age or gender.

Complication	G-T (N=152)	R (N=224)	Opt (N=37)
Migration	0	3 (1.3%)	0
Break through PE	1 (0.6%)	1 (0.4%)	0
Symptomatic caval occlusion	0	2 (1%)	4 (11%)*

$p < 0.05$ vs. both G-T and R. Conclusion: Most R-IVCFs are not retrieved. The service placing the R-IVCF should be responsible for follow up. The Optease was associated with the greatest incidence of residual thrombus and symptomatic caval occlusion. The practice patterns of R-IVCF placement and retrieval should be re-examined.

HISTORICAL PERSPECTIVE OF SPLENIC ARTERY EMBOLIZATION ON PATIENTS OUTCOMES

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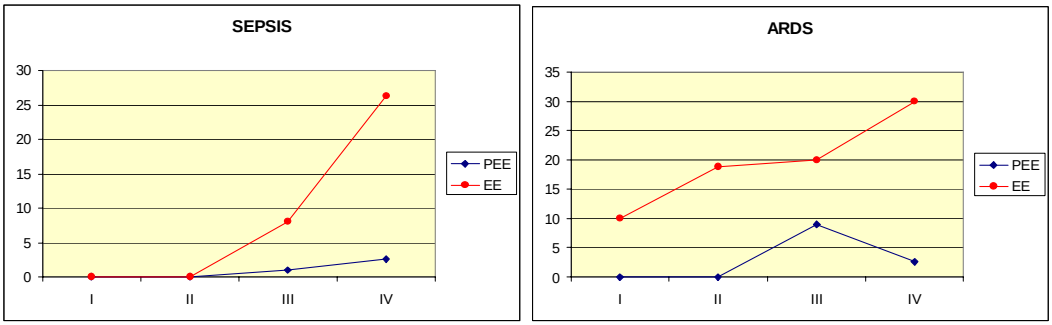
Objectives: Appropriate selection and utility of angiographic embolization (AE) for splenic injury remains under debate. We hypothesized that introduction of AE at our institution improved adult patient outcome as adjusted for splenic organ injury grade. Methods: All adult hemodynamically stable (HDS) patients with blunt splenic injury and CT evidence of contrast extravasation were identified 30 months prior and 30 months after introduction of AE. Patients in the embolization era (EE), who were first treated with AE, were compared to patients in the pre-embolization era (PEE), who underwent splenectomy, with stratification by splenic injury grade. Failure of AE was defined as performance of splenectomy. Data was analyzed by logistic regression. Results: Of 682 patients with blunt splenic injury, 154 patients were HDS with CT evidence of contrast extravasation (PEE n=78; EE n=76). There was no difference in ISS, age, mortality and LOS between PEE and EE groups. There was no failure of AE for splenic injury grades I and II. For splenic injury grades III, IV, and V failure rates were 6/25 (24%), 10/19 (52.6%) and 6/6 (100%) respectively. Although not statistical significant, EE patients tended to have a higher rate of pRBC transfusion (p=0.23). Higher development of sepsis and ARDS was noted:



p = .0319 OR 10.761 95%CI (1.228-94.334) p = .0763 OR 1.78 95%CI (0.698-4.544)
Conclusion: AE was associated with trends of increased sepsis, ARDS and pRBC transfusion. Failure of AE increased with increasing splenic injury grade. Caution in use of AE for high-grade splenic injuries is warranted.

IMPLEMENTATION OF A RAPID RESPONSE TEAM DECREASES CARDIAC ARREST OUTSIDE OF THE ICU

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Background: Patient safety and preventable in-hospital mortality remain crucial aspects of optimum medical care and continue to receive public scrutiny. Signs of physiologic instability often precede overt clinical deterioration in many patients. The **purpose** of this study was to evaluate our early experience with implementation of a rapid response team (RRT) which would evaluate and treat non-ICU patients with early signs of physiologic instability. We **hypothesized** that early evaluation and intervention prior to deterioration would avoid progression to cardiac arrest in patients on the floor.

Methods: In March 2003, our urban level I trauma center implemented an RRT to react to patient clinical deterioration on the floor; in effect, bringing critical care to the bedside. This team is available 24/7 and consists of an intensivist, an ICU nurse and a respiratory therapist. Activation criteria include: pulse < 40 or >130, systolic BP < 90, respiratory rate < 8 or > 24, seizure, an acute change in mental status and nursing staff concern for any other reason. Data were prospectively collected, including the number of RRT activations and the occurrence of in-hospital cardiac arrest.

Results: Between March and December 2005, the RRT was activated 76 times. All RRT activations were reviewed and felt to be appropriate. During the same time period the year prior to initiation of the RRT, there were 27 non-ICU cardiac arrests. Following RRT implementation, there were 13 cardiac arrests that occurred on the floor, representing just over a 50% reduction in cardiac arrest. Medical staff feedback regarding the RRT was uniformly positive.

Conclusions: Implementation of the RRT was well-received by the hospital staff. Despite initial concerns to the contrary, the RRT was not over-utilized. RRT activation resulted in early patient transfer to a higher level of care and avoided progression to cardiac arrest.

RACIAL DISPARITIES IN LONG-TERM FUNCTIONAL OUTCOME AFTR TBI

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Objective: Worse outcomes in ethnic minorities have been identified in patients with myocardial infarction, cancer, diabetes, and other diseases. The existence of similar disparities in outcome after injury has not been previously examined. We hypothesized that ethnic disparities in outcome occur after injury. We focused on traumatic brain injury (TBI) because it is a leading cause of injury-related death and disability.

Methods: The study was conducted in a large urban Level 1 trauma center in an ethnically diverse community. Functional outcome was measured in 358 patients (1998-2005) with severe TBI (AIS 3-5) 6-12 months post injury using the Glasgow Outcome Score-Extended (GOSE). Outcomes were classified as good recovery (GOSE 7 and 8) or moderate to severe disability (GOSE 1 to 6). Logistic regression was used to measure the association between minority status and functional outcome while controlling for age, gender, ISS, head AIS, admission GCS, rehabilitation placement, and insurance status.

Results: Minority and non-minority groups had similar ISS, GCS and head AIS. Ethnic minorities were less likely to be insured (uninsured 67% vs. 31%, p <.001), but were equally likely to be placed in a rehabilitation facility upon trauma center discharge (47% vs. 42%, p .417). Despite equal access to acute rehabilitation, after adjustment for age, gender, mechanism, ISS, head AIS, GCS, and discharge disposition, ethnic minorities were 2.5 times more likely to have moderate to severe disability at follow-up, compared to non-minorities (74% vs. 62%, OR 2.49, 95% CI 1.41-4.40, p .002)**.** The relationship between ethnicity and functional outcome became insignificant when insurance status was taken into account (OR 1.36, 95% CI 0.59 to 3.14, p 0.469).

Conclusion: Ethnic minorities have significantly worse long-term functional outcomes after severe TBI. This appears to be attributable to lack of health insurance despite similar access to acute rehabilitation. Improving access to health insurance may remedy the disproportionate long-term burden of TBI-related disability on minority patients.

THE DIRECT ECONOMIC BURDEN OF BLUNT AND PENETRATING TRAUMA IN A MANAGED CARE POPULATION

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Objective: Few studies have examined the direct economic burden of traumatic injury to third-party payors. We estimated total per patient charges for resources utilized by patients with blunt or penetrating trauma in a population of managed care organization (MCO) enrollees. **Methods**: Retrospective claims from the Ingenix MCO database were analyzed for 12,554 adults (age ? 18) hospitalized for blunt or penetrating trauma between 1/1/03 and 2/1/05. Charges for all trauma and non-trauma related health care resources were estimated over a 6-month period following initial injury. Patients had ? 6 months of health plan enrollment prior to and following initial injury. Three cohorts were examined: isolated traumatic brain injury (TBI); other blunt or penetrating trauma with TBI; and other blunt or penetrating trauma without TBI. Cohorts were identified using ICD-9 diagnoses from standard definitions for claims data. **Results:** Baseline population characteristics are shown below, including mean age and AIS at initial injury, and Charlson comorbidity index (CCI) over 6 months prior to initial injury. Mean total charges per patient are shown below by cohort and cost category.

Cohort	N	Age	AIS	CCI
Isolated TBI	2,133	49.70	2.55	0.92
Other Trauma, w/ TBI	2,218	43.21	2.98	0.50
Other Trauma, w/o TBI	8,203	53.99	2.25	1.18

Cohort	Index Hospitalization	Post-Discharge Medical Encounters		
		Subsequent Hospitalizations	Outpatient & Other Ancillary	Pharmacy
Isolated TBI	$32,676	$5,992	$9,381	$1,003
Other Trauma, w/ TBI	$103,853	$6,927	$16,028	$840
Other Trauma, w/o TBI	$43,387	$6,955	$11,658	$1,188

Conclusion: Charges incurred during the index hospitalization were > 36% higher among patients with both TBI and other trauma compared to the other cohorts combined. When examining total charges, the premium for combination trauma was nearly 14%. To avoid foreseeable losses, trauma centers must be aware of these heightened charges when negotiating reimbursement levels with MCOs.

Autopsy Data in the Peer Review Process Improves Outcome Analysis

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Background –The value of autopsy findings has been questioned in peer review at mature trauma centers. We sought to determine the impact of autopsy data on the peer review process.

Methods – This was a retrospective study. Data analyzed included mortality type (DOA/Immediate; Early ? 48º; Late > 48 º), ISS, TRISS-generated probability of survival (Ps), peer review judgment of preventability and findings at autopsy. Deaths were assigned to a category, then, Pre and post-autopsy ISS, Ps, and outcomes of the peer review process (%NP = % non-preventable) were compared**.** Paired t-tests (alpha = .05) were performed to determine if changes in ISS and Ps were statistically significant. All descriptive and inferential analyses were based on cases with pre- and post-autopsy data for the relevant variables.

Results – Of the 170 deaths, 126 deaths had an autopsy performed (74.12%). 112 autopsy reports were available (89.89%). Autopsy data resulted in statistically significant changes in ISS for each mortality category (DOA/Immediate: $t(39) = -3.88$, $p < .001$; Early: $t(27) = -2.55$, $p < .02$; Late: $t(18) = -2.41$, $p < .03$) and in Ps for the DOA/Immediate [$t(31) = 3.34$, $p < .003$] and Early [$t(22) = 2.21$, $p < .04$] categories. There were also autopsy-related changes in peer review outcomes for DOA/Immediate and Late deaths but not for Early deaths. The proportion of overall agreement between pre- and post-autopsy outcomes for the DOA/Immediate category was 94.34% (50/53); three deaths initially deemed NP were re-classified as PP following autopsy. Overall agreement for the Late category was 86.96% (20/23); one PP was re-classified as NP and two NPs were re-classified as PP.

Conclusion – Autopsy data enhances peer review in DOA/Immediate and Late death after injury but did not impact peer review in Early deaths. Autopsy data was most important to the analysis of Late deaths. Targeting autopsy performance to these categories is an effective strategy for centers with constrained access to autopsy data.

BLUNT SPLENIC INJURIES: HAVE WE WATCHED LONG ENOUGH?

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Blunt Splenic Injuries: Have We Watched Long Enough?

Objective: To establish a consensus time to safely discontinue inpatient non-operative management (NOM) of blunt splenic injury (BSI). **Introduction:** Over the past 20 years NOM of BSI has become common practice. There is no evidence based standard of care regarding the appropriate time to safely discontinue inpatient observation. **Methods:** Data on blunt splenic injury from the NTDB from 1996-2002 was analyzed. The time to operation was calculated as well as characteristics of the operative and non-operative groups. **Results:** 1.22 million patients had 34,359 splenic injuries of which 31,529 resulted from blunt trauma. There were 24,175 patients over 16 years of age. Of these, 19,149 patients did not undergo surgery and 5026 did (20.8%). The average time to operation was 25.4 hours, but 4,512 patients (89.8%) had surgery in the first 24 hours. By 48 hours 4677 patients had surgery (98.6%) and by 72 hours 4749 patients had surgery (98.9%, see Figure 1). The grade of splenic injury was higher in the operative group vs. the non-operative group {3.1 vs. 2.4 ($p < 0.01$)}, as was the ISS value {29 vs. 21.6 ($p<0.01$)}.

Figure 1. Time to OR after blunt splenic injury

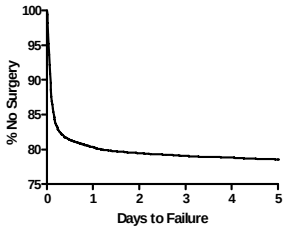


Figure 2. Influence of grade on success of non operative management of blunt splenic injuries

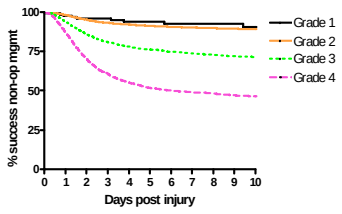
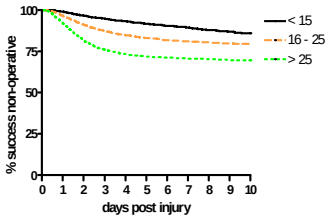


Figure 3. Influence of ISS on success of non operative management of blunt splenic injuries



Conclusion: Currently, ~80% of blunt splenic injuries can be successfully managed non-operatively. Patients with higher grade of BSI were more likely to fail NOM, as were patients with a higher ISS. The risk of requiring surgery for a splenic injury after 48 hours is ~1%. Inpatient monitoring of splenic injury can be discontinued safely after this time.

THE UTILITY OF SERIAL CT IMAGING OF BLUNT SPLENIC INJURY – STILL WORTH A SECOND LOOK?

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Background: Serial CT imaging of blunt splenic injury (BSI) can identify the latent formation of splenic artery pseudoaneurysms (PSA), contributing to improved success in splenic salvage. The practice of serial CT imaging, however, has not been embraced. The purpose of this study was to re-evaluate the clinical practice of serial CT imaging within the context of an institutional protocol for the nonoperative management (NOM) of BSI.
Method: Consecutive patients with BSI selected for NOM were identified from our trauma registry. Patients were managed according to protocol, whereby hemodynamically stable patients with PSA on initial or follow-up CT imaging were referred for angiography. Follow-up CT was performed 24 to 48 h after the initial CT. Data were abstracted from hospital, clinic, and radiology records, and included age, Injury Severity Score (ISS), splenic injury grade (SIG), and CT findings. The incidence and timing of PSA identification with respect to subsequent management and outcome were reviewed.
Results: Of 426 BSI admissions over a 2.5-year period, 341 (80%) were selected for NOM. Mean follow-up was 39 days with 76% followed for ? 7 days. Serial CT imaging resulted in the angiographic detection of 14 (4%) early PSA and 11 (3%) latent PSA. PSA were associated with increasing SIG ($p<0.001$); however, 26% of PSA were observed in SIG 1 and 2. Embolization was successful in 13/14 (93%) of early PSA and 10/11 (91%) of latent PSA. The splenic salvage rate for all patients selected for NOM over the study period was 329/341 (97%).
Conclusions: Adherence to a NOM protocol guided by serial CT imaging has resulted in one of the highest splenic salvage rates reported to date. Identification and embolization of latent PSA likely contributes to NOM success, given the unfavorable natural history of these lesions. Although PSA formation is correlated with increasing SIG, PSA are not exclusive to higher-grade injury, warranting serial CT surveillance regardless of SIG.

ABDOMINAL INSUFFLATION FOR CONTROL OF BLEEDING AFTER SEVERE SPLENIC INJURY

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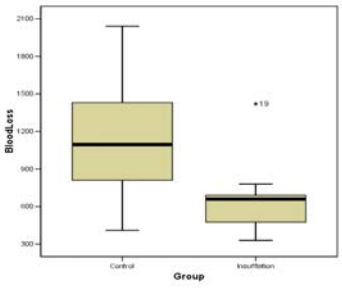
Background: To date there is no method to control intracavitary bleeding without an operation. Over 70% of trauma deaths from uncontrollable internal bleeding occur early after injury before an operation is feasible. Abdominal insufflation (AI) by carbon dioxide has been shown to reduce the rate of bleeding after intra-abdominal injury in pigs. The concept was proven in highly lethal models of severe vascular and liver injury. Similar injuries in humans would result in immediate exsanguination and low chance for any intervention. We hypothesized that AI will similarly reduce bleeding in a model of moderate but persistent bleeding from a splenic injury. This model represents a human injury scenario of continuous bleeding, which does not kill the patient immediately but may ultimately result in death if not managed early.

Methods: A new model of splenic injury was applied on 19 pigs, randomized to standard resuscitation (CONTROL, 10) or AI by CO_2 to 20 cmH_20 (INSFL, 9). Over 30 minutes the pigs were bled and hemodynamics recorded. After 30 minutes, the abdomen was opened and free blood collected and measured. Outcomes were: 1) blood loss, 2) mean arterial pressure, and 3) hemoglobin at the end of the experiment

Results: All pigs survived to the end of the experiment.

	CONTROL	*INSUFFL*	*p*
Blood loss final (ml)	1,114 ± 486	666 ± 323	0.03
MAP baseline (mmHg)	92 ± 14	90 ± 10	0.78
MAP final (mmHg)	64 ± 12	54 ± 8	0.04
Hgb baseline (mg/dl)	10.6 ± 0.9	11.3 ± 1.5	0.26
Hgb final (mmHg)	9.7 ± 1.4	8.9 ± 2.1	0.25



Conclusions: AI is a novel method to control intra-abdominal bleeding temporarily. With proper portable instruments and first-responder training, this is a technique that can potentially be used in the field to save lives from intra-abdominal exsanguination.

Immunocompetence of the Severely Injured Spleen Verified by Differential Interference Contrast Microscopy; the Red Blood Cell Pit Test.

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Objective: To determine the immunocompetence of the successfully nonoperatively managed injured spleen warranting vaccinations for Overwhelming Postsplenectomy Sepsis by differential interference contrast microscopy (DICM). **Methods**: Cull an urban level I trauma systems data bank for all patients with grade IV or V splenic injuries (those with the greatest potential to compromise immunological function) successfully managed nonoperatively and those who've required splenectomies since 1996 and verify the AAST grading. Contact/obtain written consent of these patients and acquire a blood sample for DICM (RBC Pit analysis) and IgM levels (as a control). Compare values of those sustaining splenic injuries to two control groups; patients with splenectomies and those with normal splenic function. **Results:** 40 patients were contacted, consented and volunteered blood samples; 10 pts with grade IV splenic injuries, 1 patient with a grade V injury, 14 patients with splenectomies and 15 controls. Average RBC Pit levels and IgM levels for patients sustaining injuries (15) and successfully nonoperatively managed were 0.6% (0-2% nl) and 91mg/dl (46-304 nl) respectively. Patients with splenectomies had levels of 20.4% and 86 mg/dl while controls had levels of 0.7% and 110 mg/dl respectively. The average time frame from injury to RBC Pit test was 3.1 yrs. Comparing the successfully nonoperatively managed group to the splenectomy group using T-test with Satterthwaite's Method due to unequal variances, there was a statistically significant difference ($p=0.0002$). Comparing the same study group to those with normal splenic function using T-test with pooled variance, there was no statistical significant difference between groups ($p=0.489$). **Conclusion:** Differential interference contrast microscopy, a commonly used test to evaluate splenic-based immunocompetence in patients with sickle cell anemia, hemoglobinopathies and patients undergoing partial splenectomies, also confirms splenic immunocompetence in patients sustaining up to grade IV splenic injuries. IgM levels earlier thought to be low in patients after splenectomy normalize.

Effect of protocolized angioembolization in severe liver injuries

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Objective: Although non-operative management (NOM) has become standard practice in blunt liver injuries, operative intervention remains necessary in a significant number of patients. Angioembolization (AE) has been introduced as an adjunct to both operative and NOM of severe liver injuries, but its role has yet to be defined. We hypothesized that protocolized AE in OIS grade 3-5 liver injuries would reduce laparotomy rate and would be efficient as an adjunct to damage control surgery with packing.

Methods: On 8/1/02 a protocol for treating liver injuries incorporating AE as an adjunct to both operative and NOM was instituted at the largest trauma centre in Norway. All adult patients admitted with liver injuries during a 24 month period were prospectively included (group 2), and compared with a historic control (group 1) consisting of consecutively registered patients during the 24 months prior to the new protocol.

Results: 55 patients were included in group 1 and 59 in group 2. Mean ISS was 31 ± 18 and 31 ± 15, respectively. The groups were statistically comparable. The emergency laparotomy rate decreased from 27 (49%) in group 1 to 14 (24%) in group 2 ($p<0.05$). Angiography was performed in 25 patients in group 2 (42%); in 18 patients as an adjunct to NOM, and in 7 patients after emergency laparotomy with packing. Angiography was negative in all the 8 NOM stable patients with OIS grade 3 injuries. Of the patients undergoing angiography, embolization was performed in 4 of the remaining 10 NOM patients (40%) and in 3 patients after operative treatment (43%). There was a trend towards decreased transfusion and complication rate without increase in mortality in group 2.

Conclusion: Introducing a protocol with the use of AE in severe liver injuries decreased laparotomy rates without increasing transfusion and complication rates or mortality. AE is a valuable adjunct after packing of liver injuries. Angiography is not justified in stable OIS grade 3 liver injuries with no clinical or radiological signs of bleeding and the protocol in our institution has been changed accordingly.

PREPERITONEAL PELVIC PACKING FOR HEMODYNAMICALLY UNSTABLE PELVIC FRACTURES: A PARADIGM SHIFT

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Background: The current management of patients who are hemodynamically unstable with pelvis fractures (HUPF) in the United States consists of aggressive resuscitation, mechanical stabilization, and angioembolization. Despite this multidisciplinary approach, our recent analysis confirms an alarming 40% mortality in these high-risk patients. European trauma groups have suggested the technique of preperitoneal pelvic packing (PPP) to directly address the source of pelvic fracture hemorrhage based on the fact greater than 85% are venous. We *hypothesized* that PPP reduces need for angiography, decreases blood transfusion requirements, and lowers mortality.

Methods: All patients at our ACS-verified level-I trauma center with HUPF underwent PPP/external fixation, according to our protocol, from June 2004 to February 2006.

Results: During the study period, 19 consecutive patients underwent PPP. There was one protocol deviation for pre-PPP angiography to evaluate an extremity vascular injury. The majority were men (79%) with a mean age of 39 ± 4.4 years and a mean ISS of 55 ± 3.0. The mean ED systolic blood pressure was 81 mmHg ± 3.1, heart rate was 118 ± 5.1, and base deficit 12 ± 0.8. Patients required 4 ± 1.2 units of PRBCs during 57 ± 10 minutes in the ED. Blood transfusion requirements prior to postoperative SICU admission compared to the subsequent 24 postoperative hours were significantly different (12 ± 2.0 versus 7 ± 1.6; p=0.03). The first 10 patients underwent routine angiography post-PPP, with 6 negative studies and 4 patients undergoing pre-emptive embolization; the subsequent 9 patients did not undergo angiography. One patient developed a superficial wound infection and another an infection of the pelvic space. Four (21%) patients died from MOF (2), withdrawal of care (1), or PEA arrest (1); there were no deaths due to acute blood loss.

Conclusions: PPP is a rapid method for controlling pelvic fracture-related hemorrhage that can supplant the need for emergent angiography. There is a reduction in blood product transfusion and mortality following PPP in this select high-risk group of patients.

EVALUATION OF A NEW SURGEON PERFORMED TRANSTHORACIC ECHOCARDIOGRAPHY EXAMINATION IN TRAUMA PATIENTS

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OBJECTIVE We developed a surgeon performed **transthoracic** echocardiography examination (sTTE) to rapidly assess cardiac function and hemodynamic status in trauma patients. The objectives of this study are: 1) To evaluate the utility sTTE in the emergency department (ED) and during resuscitation and 2) To determine the usefulness of this information in management. **METHODS** 21 Trauma patients with a systolic blood pressure of <90 mmHg in the field or on arrival were enrolled in this prospective study and randomized to two groups: sTTE and no sTTE. The need for informed consent was waived by the IRB. The sTTE group underwent echocardiography during the secondary survey, at 24, 48 and 72 hours. Images were recorded. To determine the central venous pressure (CVP), the diameter of the vena cava was measured at the atrial-caval junction during inspiration and expiration. The parasternal long axis and the apical 4-chamber views were used to obtain the ejection fraction (EF). Central venous and pulmonary artery catheter measurements and the volume of fluids infused were collected continuously. All sTTE results were reviewed by a board-certified cardiologist blinded to the patient's data. If the patients had *formal* echocardiography, the sTTE measurements were also compared to these measurements. Correlation analysis (Pearson correlation coefficient) was used to examine the relationship between sTTE measurements and the variables of interest. **RESULTS** CVP determined by sTTE correlated significantly with the central catheter CVP ($p = 0.039$, $r = 0.897$). EF measured by sTTE correlated significantly with EF determined by the cardiologist measurements ($p = 0.421$, $r = 0.594$). There was no significant difference in the total time that patients were in ED (sTTE group, 38 min.; no sTTE, 31 min.). **CONCLUSIONS** sTTE provides a rapid non-invasive assessment of cardiac function and hemodynamic status during the secondary survey. EF and CVP can be determined and monitored during resuscitation with serial exams. sTTE may be a potential adjunct to screen and guide resuscitation in trauma patients.

IMPROVING CONSENT RATES FOR ORGAN DONATION: THE EFFECT OF AN IN-HOUSE COORDINATOR PROGRAM

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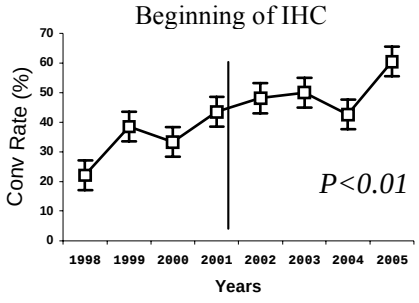
Introduction: The inability to obtain consent remains one of the major obstacles to donation. Having in-house coordinators (IHC) from organ procurement organizations (OPO) has been suggested as a way to improve donation rates. The IHC would assist in donor surveillance, ensure early referral, provide hospital staff education, assist with donor management and provide family support. **Objective:** To review the effects of the presence of an IHC on organ donation rates at our center. **Methods:** Retrospective analysis of patients referred to the regional OPO for possible organ donation. An IHC program was started at our hospital towards the end of 2001. Data regarding organ donation, demographics and family consent rates were compared before (Pre-IHC, 1998-2001) and after (Post-IHC, 2002-2005) the institution of an IHC program. The conversion rate (Conv Rate) was calculated as the number of actual donors divided by the number of potential donors and is represented as a percentage. **Results:** There were a total of 495 potential donors and 195 actual donors during the 8-year time period. The table and figure below demonstrates the effect of IHC program.

Conclusion: The presence of an IHC program significantly improves consent and conversion rates for organ donation. An IHC program should be considered as a viable option to bridge the gap between organ supply and organ demand.

	Pre-IHC	Post-IHC	p
Potential Donors (n)	287	208	na
Actual Donors (n)	92	103	<0.01
Consent Rate (%)	35.2	52.0	<0.01
Conv Rate (%)	34.5	49.5	<0.01
Organs/Donor	3.5	3.6	0.43



Postmortem Computed Tomography (CATopsy) Predicts Cause of Death in Trauma Patients

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Purpose: To determine if a postmortem computed tomographic scan ("CATopsy") can be used to determine cause of death in a group of trauma patients.

Methods: This was a prospective IRB approved study comparing CATopsy to the gold standard, autopsy, for determining cause of death in trauma patients. The study population was limited to those patients who presented to the trauma service and subsequently died within the first 24 hours of their hospitalization; any patient who underwent an operation within this time frame was excluded from the study. Following pronouncement of death, each patient had a CATopsy performed, which was a noncontrast whole body (head to knees) scan. A single attending radiologist read each of these films. A panel of three trauma surgeons then reviewed the details of each case as well as the CATopsy results and proposed a cause of death for each patient. The study patients also each underwent an autopsy. These results were compared to those generated by the CATopsy.

Results: There were 12 patients enrolled in the study; all died as a result of blunt trauma. Mean patient age was 31 years; average ISS was 33.5+/-19.0. In 10 of 12 cases (83%), the CATopsy successfully predicted cause of death when compared to the autopsy. In those two patients in whom there was disagreement, the CATopsy did demonstrate all of the injuries noted in the autopsy. 7 of 12 (58%) of the CATopsies demonstrated air in various parts of the circulatory system, including the heart in 4 cases. 3 of 12 (21%) patients had clinically significant findings (including the presence of a tension pneumothorax) noted on the CATopsy not previously identified on any radiographic studies and/or on the autopsy. These finding were addressed as part of our performance improvement process.

Conclusion: This preliminary study suggests that a postmortem imaging test, a CATopsy, can be used to predict cause of death in trauma patients. Beyond offering a noninvasive alternative to autopsy, it provides similar information to that provided in post-mortem examination and may be used in trauma performance improvement activities.

AFRICAN AMERICAN CHILDREN EXPERIENCE WORSE CLINICAL AND FUNCTIONAL OUTCOMES AFTER TRAUMATIC BRAIN INJURY: AN ANALYSIS OF THE NATIONAL PEDIATRIC TRAUMA REGISTRY

Adil H Haider MD MPH- Johns Hopkins School of Medicine, Dave Efron MD- Johns Hopkins School of Medicine, Elliott Haut MD-Johns Hopkins School of Medicine, Stephen DiRusso MD PhD*- St Barnabas Hospital, Thomas Sullivan BS- New York Medical College and Edward E Cornwell MD*-Johns Hopkins School of Medicine

Background: Recent studies suggest racial disparities in the treatment and outcomes of children with traumatic brain injury (TBI). **Objective**: To identify racial differences in clinical and functional outcomes among pediatric TBI patients in a national database. **Methods:** Retrospective review of 41,122 patients (ages 2-16) included in the National Pediatric Trauma Registry from 1994 through 2001. TBI was categorized by Relative Head Injury Severity Score (RHISS) and patients with moderate to severe TBI were included. Individual race groups were compared to Whites-the majority group. Differences between races in functional outcomes at discharge in three domains: Speech, Locomotion and Feeding were determined using multiple logistic regression. Cases were adjusted for age, sex, severity of head injury (using RHISS), severity of injury (using New Injury Severity Score (NISS) and Pediatric Trauma Score), pre-morbidities, mechanism and injury intent. **Results**: 7,778 children had moderate-severe TBI with or without associated injuries. All races had similar mean age (8 years), sex distribution (64% male), mean NISS (24.3) and RHISS (2.3) scores. Hispanics (n=1041) and other races (n=737) had outcomes comparable to Whites. African Americans had significantly increased pre-morbidities, penetrating trauma and violent intent. African Americans also had higher mortality than Whites (14% and 10% respectively*) and longer mean ICU (3.5 vs. 2.8 days*) and floor (3.3 vs. 2.8 days*) stays (*p<0.01). African Americans had increased deficits in all 3 domains studied.

Functional Domain	Percentage of patients with functional deficit at discharge		Adjusted Odds of African American child having deficit compared to equivalently injured White child
	White (n=4762)	AfricanAmerican (n=1238)	
Speech	13*	17*	1.3*
Locomotion	22*	27*	1.4*
Feeding	15*	19*	1.4* (*p<0.01)

Conclusion: African American children with traumatic brain injury have worse clinical & functional outcomes at discharge when compared to equivalently injured White children.

THE EFFECT OF INHALATION INJURY ON HYPERMETABOLISM IN SEVERELY BURNED CHILDREN

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Introduction: The metabolic response to stress leads to the release of catecholamine, glucagon and cortisol causing a severe catabolic reaction and increases in energy expenditure. A correlation between burn size and metabolic rate has been well established. However, the presence of an inhalation injury, in addition to a severe burn, has not been well-recognized as increasing the hypermetabolic stress response. The purpose of this study was to assess the influence of inhalation injury on resting energy expenditure in the severely burned pediatric population. **Methods:** A total of 101 severely burned children with total body surface area burns ? 40%, between 1 to 18 years of age, were assigned to one of two groups: inhalation injury or no inhalation injury based on bronchoscopic evaluation. Patients that did not survive through their acute hospitalization were dropped from this study. Indirect calorimetry was performed at the bedside between midnight and 0500 at admission, at the height of the hypermetabolic response and again at discharge. Study variables include measured resting energy expenditure (MREE), % of predicted REE and oxygen consumption (VO_2). Data are presented as mean ± standard error of the mean (SEM). Significance was accepted at $p < 0.05$ using an unpaired t-test. **Results:** On admission, MREE was 1548.6 ± 112.8 kcal/day, % predicted REE was 128.4 ± 6.7 % and VO_2 was 214.7 ± 15.4 l/min with inhalation injury vs. 1557.1 ± 127.5 kcal/day, 137.6 ± 7.7 % and 215.8 ± 16.7 without inhalation injury ($p = 0.897$, 0.356 and 0.997, respectively). Seven days later, MREE was 1725.8 ± 128.2 kcal/day, % predicted REE was 145.7 ± 8.1 % and VO_2 was 242.4 ± 18.5 l/min in children with inhalation injury in comparison to 1531.5 ± 112.4 kcal/day, 137.6 ± 7.7 % and 199.6 ± 13.8 l/min in the no inhalation injury group ($p = 0.260$, 0.359 and 0.105, respectively). At discharge, MREE was 1514.8 ± 87.5 kcal/day, predicted REE was 133.8 ± 4.9 % and VO_2 was 209.3 ± 11.3 l/min in the inhalation group vs. 1408.7 ± 80.5 kcal/day, 123.5 ± 3.4 %, and 193.6 ± 11.5 l/min in the no inhalation injury group ($p =0.336$, 0.092 and 0.413). There were not any significant differences found between groups at each of the indicated time points. **Conclusion:** Inhalation injury in severely burned children does not augment the hypermetabolic stress response as reflected in measures of resting energy expenditure and oxygen consumption as compared with a cutaneous burn alone.

TOLL-LIKE RECEPTOR 2 AND 4 LIGATION RESULTS IN COMPLEX ALTERED CYTOKINE PROFILES EARLY AND LATE AFTER BURN INJURY

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Objective: Burn injury is associated with an early (3 day) suppression and a late (14 day) enhancement of CD8+ T cell immune responses. In addition, toll-like receptor (TLR) expression is altered on innate immune cells that mediate cytokine secretion following burn injury. In this study, we hypothesized that cytokine secretion profiles generated after TLR2 or TLR4 ligation mediate the T cell responses observed following burn injury.
Methods: Female C56Bl/6 mice were subjected to 20% full thickness scald burn or sham and sacrificed at 3 or 14 days. Splenocytes were cultured with TLR2 ligand (PGN, 10μg/ml) or TLR4 ligand (LPS, 1μg/ml) for 48 hours with 2% syngeneic mouse serum. Culture supernatants were assayed for TNFα, IL-6 (pro-inflammatory) and IL-10 (anti-inflammatory) cytokines by flow cytometric bead array and analyzed using Student's t-test.
Results: TLR4 ligation results in increased secretion of all cytokines tested (*$p<0.05$; **$p<0.005$, $n>3$ per group) at 3 and 14 days after burn injury. In addition, TLR2 ligation significantly increases TNFα and IL-10 but not IL-6 secretion (**$p<0.005$) at 3 days, but results in only a significant increase of IL-10 (*$p<0.05$) 14 days after burn injury (Table).
Conclusions: Cytokine secretion profiles following TLR2 and TLR4 ligation are altered early (3 days) and late (14 days) after burn injury in a manner that is not clearly reflective of an anti-inflammatory or pro-inflammatory state at either time point. TLR2 and TLR4 ligation have complex and varied roles in mediating the immune response to burn injury.

Day 3 [Cytokine] [mean±SEM pg/mL	PGN **Sham**	PGN **Burn**	LPS **Sham**	LPS **Burn**
TNFα	2977±151.4	5000±19.13**	560.3±56.2	1172±104.2**
IL-6	90.58±9.55	119.9±18.48	84.50±17.99	148.25±15.31*
IL-10	266.9±23.28	2143±275**	0.05±0.02	24.28±2.073**
Day 14				
TNFα	434.6±21.54	424.5±31.64	565.2±21.69	709.5±13.33*
IL-6	147.1±59.94	51.86±6.545	137.6±39.91	374.0±39.81*
IL-10	34.81±0.490	78.51±4.865*	48.73±0.275	121.5±22.33*

REVERSAL OF PARENTERAL NUTRITION-INDUCED GUT MUCOSAL IMMUNITY IMPAIRMENT WITH SMALL AMOUNTS OF A COMPLEX ENTERAL DIET

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Background: Although parenteral nutrition (PN) prevents progressive malnutrition, lack of enteral nutrition (EN) during PN leads to gut associated lymphoid tissue (GALT) atrophy and dysfunction. Though small amounts of EN with PN reportedly prevent increases in intestinal permeability, effects on GALT remain unclear. We determined the minimum amount of EN needed to preserve gut immunity during PN. Methods: Male ICR mice (n= 37) underwent jugular vein catheter insertion and tube gastrostomy and were randomized into four isocaloric, isonitrogenous nutritional support groups with variable EN to PN ratios (EN0, EN33, EN66 and EN100). EN was provided with a complex enteral diet. After 5 day feeding, mice were killed and the entire small intestine was harvested. GALT lymphocytes were isolated and counted, their phenotypes determined by flow cytometry. IgA levels in small intestinal washings were determined with ELISA.

Results: Body weight changes did not differ between any two groups. Peyer's patch lymphocyte numbers increased in proportion to EN amounts, while lamina propria lymphocyte numbers were significantly higher in the EN 100 than in the EN 0 group, with no marked increase in the EN 33 or the EN 66 group (Figure 1 and 2). Small intestinal IgA levels increased EN amount-dependently, reaching a plateau at EN 66 (Figure 3).

Conclusions: A small amount of EN partially reverses PN-induced GALT changes, but does not restore lamina propria cell numbers, suggesting limited beneficial effects on gut mucosal immunity.

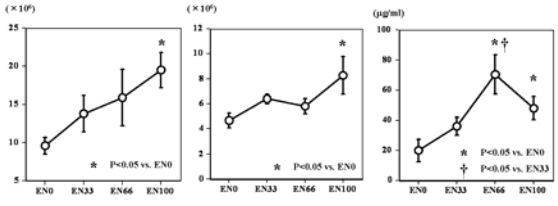

Fig.1 Peyer's Patch Lymphocyte counts

Fig.2 Lamina Propria Lymphocyte counts

Fig.3 Small Intestinal IgA Level

Calorically Dense Enteral Nutrition Formulas worsen outcome in Trauma and Surgical Critically ill Patients

Jodie Bryk, Mazen Zenati, PhD, Raquel Forsythe, MD*, Andrew Peitzman, MD*, and Juan B. Ochoa, MD

Introduction: Critically ill Trauma (TP) and surgical patients (SP) are traditionally provided with calorically dense formulas (CDF) in an attempt to deliver high amounts of nutrients. Despite this, the benefits of CDF remains unproven. Furthermore, recent reports suggest that the provision of high amounts of calories may be associated with significant side effects and even increased mortality. We therefore studied outcomes on critically ill SP and TP receiving either a CDF or a normo-caloric formula (NCF).

Methods: A retrospective analysis of all critically ill SP and TP admitted to two intensive care units in a University Hospital during 2004 were studied. Data was abstracted from a computerized database (EMTEK®). Analysis was done using STATA®. Mann-Whitney two sample ranksum test was used to determine statistically significant differences existed between groups at a value of $p<0.05$. Data is presented as means $\pm$ standard deviation.

Results: 117 met study criteria. Because of demographic differences, surgical (non-trauma) and trauma patients were analyzed separately. Surgical patients (SP) receiving a CDF or NCF were comparable in age, weight, and sex distribution and Apache III scores. Even though the amounts of calories delivered in both groups were similar, SP receiving a CDF exhibited a significant increase in glucose levels (158 ± 41 vs. 130 ± 21 mg/dl, $p<0.01$). LOS and ventilator days were dramatically increased in CDF SP (25 ± 11 vs. 15 ± 10, $p<0.01$). 0% of patients receiving a CDF could be discharged home directly (vs. nursing home) from the hospital compared to 29.6% of patients receiving NCF. Even though Trauma patients (TP) receiving a CDF were on average 17 years younger ($p<0.05$) their LOS and ventilator days were still increased (15.3 ± 8.4 vs. 18.7 ± 9.0 d., $p=.02$). Equally, TP receiving a CDF exhibited a decreased chance of direct home discharge.

Conclusions: The traditional use of CDF should be revised in surgical and critically ill patients since there is no appreciable benefit and, in fact, possible harm. A prospective study should be designed to determine the ideal amounts of calories needed in SP and TP.

THE RELATIVE ROLES OF BACTERIA AND HOST INFLAMMATORY CELLS IN SIGA DEGRADATION

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Objective: Secretory Immunoglobulin (Ig) A, the most important Ig for lung defense, is highly dependent on its molecular structure for its immune activity. Proteolytic cleavage of SIgA may occur in the airways and render the SIgA molecule inactive. Previous studies have attributed IgA cleavage to neutrophils (PMNs) and other host immunoinflammatory cells in the airways, or bacterial pathogens. The resultant IgA degradation leads to airway inflammation and subsequent pneumonia. The aim of this study was to discern the relative roles of host inflammatory cells and bacteria in SIgA cleavage *in vitro*.

Methods: SIgA was cocultured with PMNs, PMNs activated with fMLP, monocytes (Øcyte), Øcytes pretreated with LPS, *Staphylococcus aureus* (MRSA), *Pseudomonas*, or *Acinetobacter* alone or with Øcyte culture supernatants and PMNs. SIgA cleavage resulted in two fractions, a < 75 kD fraction (SC fraction) and an intact SIgA fraction by size exclusion ultrafiltration. This was quantified by ELISA and confirmed by Western Blot.

Results: IgA Fraction (mean ± SD, μg/ml)

Group	SC Fraction	Intact SIgA
PMN + fMLP	23.0 ± 1.4	407.0 ± 3.4
PMN + Øcyte - LPS	24.5 ± 1.9	415.8 ± 3.6
PMN + Øcyte - LPS + MRSA	20.3 ± 1.6	419.2 ± 1.2
PMN + Øcyte - LPS + *Pseudomonas*	221.9 ± 2.4*	181.7 ± 2.5*
PMN + Øcyte -LPS + *Acinetobacter*	180.0 ± 1.3*	242.6 ± 2.6*

* $p < 0.001$ vs. all other groups

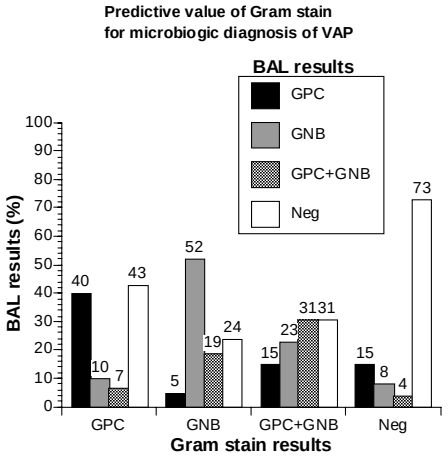
Conclusions: Bacterial pathogens, but not activated immunoinflammatory cells, were responsible for SIgA degradation in this study. This was evident only with *Pseudomonas* and *Acinetobacter.* This may be a virulence factor for pneumonia with these pathogens *in vivo*.

PREDICTIVE VALUE OF SPUTUM GRAM STAIN FOR DETERMINATION OF APPROPRIATE ANTIBIOTIC THERAPY IN VAP

Krishnan Raghavendran, MD*, Curtis Haas, Pharm D, Jiping Wang, MD, Kimberly Brunton, RN, William Flynn, MD*

Introduction: Ventilator associated pneumonia (VAP) is diagnosed in 30-50% of critically ill trauma patients with improved survival with early, appropriate antibiotic therapy. Presumptive antibiotic therapy for the first 48-72 hr is based on the sputum gram stain (GS), obtained at the time of BAL conducted for a clinical pulmonary infection score (CPIS) ≥ 6. This study was conducted to analyze the predictive value GS for selecting appropriate antibiotic therapy for VAP (>10^4 in BAL considered diagnostic).

Methods: A retrospective analysis of 84 consecutive ICU patients between 1/04 to 7/05 with CPIS ≥ 6 was performed. 128 GS and the corresponding BALs were obtained for those patients with each new incidence of VAP.



Results: If the GS showed Gram positive cocci (GPC) only, then 17% of patients would not have been adequately treated for gram negative bacilli (GNB) for the first 48-72 hr. Correspondingly, when the GS showed GNB only, then 24% of patients would not have received early appropriate therapy for GPC However, if all patients received early empiric therapy for GNB, irrespective of GS results and antibiotics for GPC were started only with evidence of GPC on GS, early appropriate antibiotics were rendered in 90% of episodes. 27% of patients who had no organisms identified on the initial GS had subsequent significant growth.

Conclusions: Irrespective of sputum GS, presumptive broad-spectrum antibiotic coverage should include dual antibiotic coverage for GNB. Gram positive coverage should be reserved for patients with evidence of GPC on the sputum GS. Additionally, identification of no organisms in the sputum gram stain should still prompt broad-spectrum antibiotic coverage till the final results of the BAL quantitative culture are obtained.

MORBIDITY REDUCTION IN CRITICALLY ILL TRAUMA PATIENTS THROUGH USE OF A COMPUTERIZED INSULIN INFUSION PROTOCOL: A PRELIMINARY STUDY

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Background: Recent data have demonstrated that strict glycemic control (GC) in critical illness improves outcome. GC in trauma patients is challenging, and no study to date has demonstrated effective glycemic control with related outcome improvements. The purpose of our study was to evaluate the effect of a computerized insulin infusion protocol (CIIP) on GC and outcome in critically ill trauma patients. **Methods:** A CIIP was implemented 7/01/05, with two finger stick blood sugars (FSBS) > 140 mg/dL triggering protocol. Utilizing patient data and initial FSBS entered by nursing, the computer calculates a sensitivity factor, infusion rate and time of next FSBS, maintaining FSBS from 70-130 mg/dL. Two six month cohorts were compared, prior to (PRE) and after (POST) CIIP, using FSBS values and NTRACS demographic, injury severity, and outcome variables for all adult trauma patients with ICU length of stay (LOS) > 72 hours. Infections were NTRACS defined, including ventilator associated pneumonia (VAP), urinary tract (UTI), and central venous line infection (CVL). Also, the percentages of patients with infections (ALL) were compared. Differences between groups were assessed using a Student's t-test and Fisher's exact test for continuous and categorical variables, with significance $p < 0.05$*. **Results:** The 129 PRE and 128 POST patients were well matched for age, gender, ethnicity, and all mean AIS values. Comparative data are displayed below.

	FSBS*	ISS	RTS	VAP%(n)*	UTI %(n)	CVL%(n)*	ALL%(n)*
PRE	130±45	26±12	5.4±2.2	36%(46)	22%(28)	8%(10)	52%(67)
POST	116±39	24±11	4.9±2.3	26%(33)	16%(20)	4%(5)	39%(50)

Total infections declined by 29% (117 PRE, 84 POST). Hospital LOS was reduced by 7 days (29 to 22; $p = 0.04$), ICU LOS by 2 (14 to 12, p NS) and ventilator LOS by 4 (14 to 10, $p = 0.03$). **Conclusion**: The CIIP significantly reduced mean FS glucose values, infectious morbidity and LOS. This preliminary study demonstrates significant morbidity and LOS reductions with the use of CIPP. Further prospective study is warranted to elucidate the efficacy of this approach.

COAGULATION AND COMPLEMENT PROTEIN DIFFERENCES BETWEEN SEPTIC AND UNINFECTED SIRS PATIENTS.

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Introduction: Systemic inflammatory response syndrome (SIRS) represents a host response to various insults. Recent advances have demonstrated an interconnection between inflammation, complement and coagulation. This experiment evaluated differences in plasma protein profiles between clinically identical patients: Septic versus uninfected SIRS patients, prior to clinical diagnosis of infection. **Hypothesis:** Septic as compared to uninfected SIRS patients will demonstrate differential protein profiles of complement/coagulation proteins prior to clinical onset of sepsis. **Methods:** Patients admitted to a trauma ICU of a major university, meeting 2 of 4 SIRS criteria were followed prospectively for development of sepsis. Whole blood samples were collected daily and divided into 2 groups: **1) Pre-septic** = patients with SIRS who subsequently developed sepsis, and **2) SIRS** = patients remaining uninfected. Pooled pre-septic samples were compared to pooled, time-matched SIRS samples. Protein profiling was accomplished by three dimensional liquid chromatography fractionation with electrospray ion trap mass spectrometry after immunodepletion of abundant proteins and a trypsin digest. Spectra peaks were identified using Agilent Technologies Spectrum Mill Workbench software. Relevance to biologic pathways was analyzed with DAVID 2.1 available at the NIH. Statistical significance was determined on DAVID 2.1 with the EASE modification of the Fisher Exact Test. **Results:** 163 unique proteins were significantly different between groups. 34 of these (20.9%) mapped to the *Complement and coagulation cascade (KEGG)*, 10 (6.1%) mapped to *Classic complement pathway;* 11(6.7%) mapped to *Complement pathway*, and 8(4.9%) mapped to *Lectin binding complement pathway (Biocarta)*. These pathways were all significantly overrepresented in sepsis patients compared to SIRS only patients (all $P<0.0001$) **Conclusion:** Using novel mass spectrometry methodology, we were able to demonstrate differential protein profiles in septic versus uninfected SIRS patients prior to clinical diagnosis of sepsis.

The Early Second Hit in Trauma Management Augments the Pro-Inflammatory Immune Response to Multiple Injury

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Today's management of multiple injured patients remains a debatable issue in regards to damage control and the appropriate timing of operative treatment ("second hit"). Among the multitude of physiological parameters critical to the immune defense and clinical course of recovery, recent research has proven the regulation of distinct pro- and anti-inflammatory mediators to be closely associated with post-traumatic outcome and complications, including SIRS and sepsis. This study sought to investigate the significance of multiple trauma and consecutive operative treatment ("second hit") in regards to the early inflammatory profile and its importance within the host's immune function. **Material & Methods:** Peripheral whole blood was obtained from 32 multiple trauma patients (ISS > 20) and 14 healthy control subjects on the day of injury (day 0) and 24 hours thereafter (day 1). Trauma patients were divided into two groups (trauma vs. trauma + immediate operation ("second hit")). Whole blood was centrifuged at 400 x g at RT for subsequent plasma collection and analyses of IL-6, IL-10 and sTREM-1 plasma concentrations by ELISA, respectively. **Results:** IL-6 plasma levels from second hit trauma patients (n=18, ISS 35.5 ± 12.2) significantly exceeded values determined in both trauma patients without a second hit (n=14, ISS 30.5 ± 5.3) and healthy control subjects (n=12) by post-trauma day 1 ($p<0.05$). IL-10 plasma concentrations on day 1 were equally and significantly elevated in both trauma patient populations, when compared to control samples ($p<0.05$). In contrast, sTREM-1 was exclusively increased in trauma patients with a second hit, suggesting a strong pro-inflammatory response in multiple trauma patients challenged with immediate surgical care ($p<0.05$). **Conclusion:** Immediate surgical treatment of multiple trauma patients augments the pro-inflammatory immune response in the early phase of recovery as determined by increased IL-6 and sTREM-1 plasma levels. If not required solely for damage control, the early second hit from additional surgical stress may promote post-traumatic complications by surcharging the innate immune response to injury.

LONG TERM BENEFIT OF EARLY HYPERGLYCEMIC CONTROL IN CRITICALLY ILL TRAUMA PATIENTS.

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Purpose: We sought to determine whether persistent hyperglycemia as compared to normoglycemia was predictive of outcome in the later stages of hospitalization in critically ill trauma patients. **Methods**: A prospective study was conducted on 896 consecutive trauma patients admitted to the ICU over a 2-year period. Patients were stratified by serum glucose level from day 1 to day 28 (low = 0-139 mg/dl, medium high = 140-219 mg/dl, and high >220 mg/dl) age, gender, race, IDDM, obesity and ISS. Patients were further stratified by pattern of glucose control (all low, all moderate, all high, improving, worsening, highly variable. Outcome was measured by ventilator days, infection, hospital (HLOS) and ICU (ILOS) length of stay and mortality. Multiple variable logistic regression models were used to determine level of significance. **Results**: 83% were victims of blunt trauma. The majority (74%) were male with a mean ISS of 26 ± 12. 443 patients were developed an infection in weeks 1 and 2, 340 in weeks 2 and 3, and 273 in weeks 3 and 4. Hyperglycemia, whether glucose levels were moderate, worsening or highly variable in the first week was associated with a significantly higher infection rate in weeks 1 and 2 when controlling for age, race, gender, ISS, mechanism of injury, obesity and IDDM ($p<0.03$). However, better glucose control in later weeks was not associated with decreased infection risk when analyzed by the same model over the subsequent weeks 3 and 4. Regardless of glucose levels in weeks 2 through 4, patients who were normoglycemic in the first week had a lower infection rate, fewer ICU, hospital and ventilator days, and were less likely to die even when controlling for age, ISS and obesity ($p<0.05$). **Conclusion:** Early glucose control is associated with improved outcome and maintains this benefit even if glucose levels are higher in subsequent weeks. Future studies regarding the mechanism of this benefit are warranted.

HYPOTENSION BEGINS AT 110 MM HG: REDEFINING "HYPOTENSION" WITH DATA

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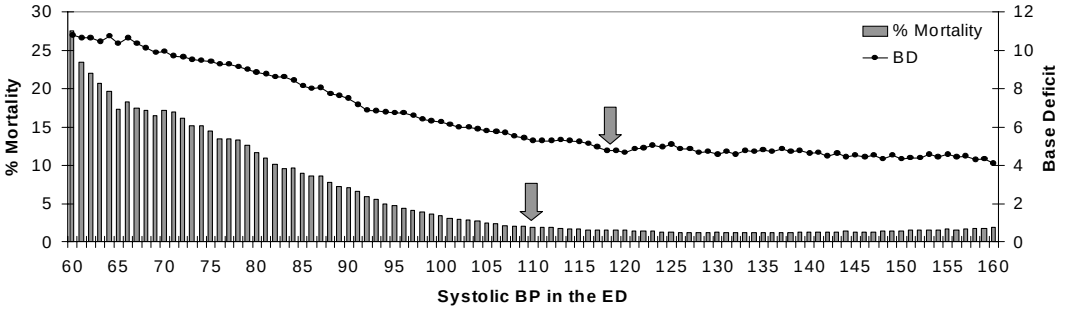
Background: Clinicians routinely refer to hypotension as a systolic blood pressure ? 90 mmHg. However, little data exists to support the rigid adherence to this arbitrary cutoff. We hypothesized that the physiologic hypoperfusion and mortality outcomes classically associated with hypotension were manifest at higher systolic blood pressures.

Methods: A total of 870,634 patient records from the National Trauma Data Bank (NTDB) with emergency department systolic blood pressure (SBP) and mortality data were analyzed. 140,898 patients with severe head injuries (GCS ≤ 8 and base deficit (BD) < 5) were excluded from analysis. Admission BD, as a measure of metabolic hypoperfusion, was evaluated in 81,134 patients and mortality was plotted against SBP.

Results: Baseline mortality was < 2.5%. However, at 110 mmHg (lower arrow), the slope of the curve increased such that there was a 4.8% increase in mortality for every 10 mmHg decrement in SBP. This effect was consistent to a maximum of 26% mortality at a SBP 60 mmHg. Also demonstrated was that hypoperfusion, as indicated by a change in the slope of BD curve, began to increase above baseline of 4.5 at a SBP 118 mmHg (upper arrow).



Conclusion: Taking the BD and mortality measurements together, this analysis shows that a SBP ≤ 110 mmHg is a more clinically relevant definition of hypotension and hypoperfusion than 90 mmHg. This analysis will also be useful for developing appropriately powered studies of hemorrhagic shock.

IN VIVO BLEEDING TIME AND IN VITRO THROMBOELASTOGRAPHY (TEG) MEASUREMENTS ARE BETTER INDICATORS OF DILUTIONAL HYPOTHERMIC COAGULOPATHY THAN PROTHROMBIN TIME (PT)

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Introduction: The coagulopathy of trauma is generally defined as PT ? 16 seconds or an INR ? 1.5. However the utility of these values as a screening test is unknown. We explored the sensitivity of various coagulation tests as indicators of bleeding and lethality of a parenchymal injury model in normal and coagulopathic rabbits, without tissue damage.

Methods: Prior to injury, coagulopathy was induced by two different methods; warfarin treatment (2mg/kg for 2 days), or by hemodilution and hypothermia (50% exchange with Hextend, 34.5±0.5°C). Male NZW rabbits (3.2±0.1 kg) were divided into 3 groups (n=7/group): 1) Normal (N); 2) Warfarin (W); 3) Hemodiluted & Hypothermic (HH). Animals were anesthetized, blood samples collected after coagulopathy induction and coagulation values measured (PT and aPTT and TEG). Laparotomy was performed, liver bleeding time measured and an uncontrolled hemorrhage created by a 5 mm deep longitudinal splenic incision. The abdomen was closed and rabbits were resuscitated with Hextend solution (25 ml/kg) to return BP to baseline. Animals were monitored for 2 hrs or until death at which time blood loss was measured. Data were analyzed by Kruskal-Wallis, Fisher's Exact, and logistic regression analysis and expressed as mean±SEM.

Results: Following injury, rabbits lived for 120 (N), 91±9(W), and 67±5*(HH) min. The most sensitive predictor of lethal bleeding was bleeding time followed by Vmax.

Grp	Platelet x1000/ul	Bleeding time (s)	PT(s)	aPTT(s)	TEG MA	TEG Vmax	Bld loss (ml/kg)	Sur vival
N	312±25	122±7.2	11.1±0.3	16.7±0.3	68.2±1.2	20.7±1.2	33.8±4.1	7/7
W	319±47	310±21*	24.6±1.2*	22.4±0.9*	69.3±1.8	3.9±0.4*	51.1±3.4*	1/7*
HH	151±16*	266±24*	11.8±0.4	24.5±1.4*	45.0±1.2*	8.2±0.5^{+}	54.6±1.6*	0/7*

* Significantly different from N group. $^{+}$ Significantly different from N or W group.

Conclusion: PT in a model of dilutional and hypothermic coagulopathy without massive tissue injury was not a valid screening test for lethal hemorrhage. All other coagulation parameters were better indicators of coagulopathic bleeding and survival.

EARLY VS LATE RECOMBINANT FACTOR VIIA USAGE IN TRAUMA PATIENTS REQUIRING MASSIVE TRANSFUSION AT COMBAT SUPPORT HOSPITALS

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Introduction: Coagulopathy is a consequence of severe trauma especially in massively transfused patients and is associated with increased mortality. Fresh frozen plasma (FFP), platelets, cryoprecipitate (cryo), and more recently rFVIIa have been used to correct early coagulopathy in trauma. We hypothesized that early (vs late) administration of rFVIIa would decrease transfusion requirements in trauma patients. **Methods:** Records from Jan 2004 to Oct 2005 for trauma admissions to Combat Support Hospitals in Iraq contained within the Joint Theatre Trauma Registry were retrospectively reviewed. Patients requiring a massive transfusion [? 10 units of packed red blood cells (pRBC) in 24 hours] and receiving rFVIIa were identified. Dose/time of administration of blood products and rFVIIa were recorded. Groups were divided into those who received rFVIIa early (? 8 units of blood) and late (> 8 units of blood). Clinical outcomes were noted. **Results:** Of 5,586 trauma admissions to the hospital, 292 (5.2%) required a massive transfusion and 97 of these (33%) received rFVIIa. Complete records for blood transfusions were available for 61 patients (of which 90% had penetrating mechanisms of injury): 17 received rFVIIa early, and 44 received rFVIIa late. Upon admission, there were no differences between early vs late groups in temperature, heart rate, blood pressure, Glasgow Coma Scale, base deficit, hemoglobin, platelets, prothrombin time/INR, or Injury Severity Score. There was no difference between FFP, fresh whole blood, or cryo administration between groups. Fewer units of pRBCs (16.7 early vs 21.7 late, p=0.03) were given to the early rFVIIa group. There were no differences in mortality (36% vs 35%, p=0.97, $\chi 2$), ARDS (5.9 vs 6.8%, p=0.89), infection (5.9% vs 9.1%, p=0.68), or thrombotic events (0% vs 2.3%, p=0.53) for the early vs late groups respectively. **Conclusions:** Although there were no observed differences in clinical outcomes, in trauma patients with primarily penetrating injuries requiring massive transfusion, early administration of rFVIIa decreased pRBC use by 23%.

ALTERNATE SITE SURGE CAPACITY IN TIMES OF PUBLIC HEALTH DISASTER MAINTAINS TRAUMA CENTER AND EMERGENCY DEPARTMENT INTEGRITY: HURRICANE KATRINA

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INTRODUCTION: Hospital surge capacity has been advocated to accommodate large increases in demand for healthcare, however, existing urban trauma centers/emergency departments (TC/EDs) face barriers to providing timely care even at baseline patient volumes. The purpose of this study is to describe how alternate-site medical surge capacity absorbed large patient volumes while minimizing impact on routine TC/ED operations immediately after Hurricane Katrina. **METHODS:** From September 1, 2005 to September 16, 2005, an alternate site for medical care was established. Using an off-site space, the Dallas Convention Center Medical Unit (DCCMU), an enhanced urgent care center approximately 8,200 ft^2 in size, was established to meet the increased demand for care. Data was collected prospectively with regards to chief complaint, treatment, and patient disposition and compared to TC/ED patient volumes to assess impact on existing facilities. The paired t-test was used for statistical analysis. **RESULTS:** During the study period, 23,231 persons displaced by Hurricane Katrina were registered to receive evacuee services in the City of Dallas, Texas. From those displaced, 10,367 visits for emergent or urgent healthcare were seen at the DCCMU. The mean number of daily visits (mean±SD) to the DCCMU was 619±301 visits with a peak on day 3 (n=1,125). No patients expired, 3.2% (n=257) were observed in the DCCMU, and only 2.9% (n=236) required transport to a TC/ED. Over the same period, the mean number of TC/ED visits at the region's primary provider of indigent care (Hospital 1) was 346±36 visits. Using historical data from Hospital 1 over the same period of time (341±41), there was no significant difference in the mean number of TC/ED visits from the previous year (p=0.26).

CONCLUSIONS: Alternate-site medical surge capacity provides for safe and effective delivery of care to a large influx of patients seeking urgent and emergent care. This protects the integrity of existing public hospital TC/ED infrastructure and ongoing operations.

TARGETED PREHOSPITAL VENTILATION IS ASSOCIATED WITH IMPROVED OUTCOME FOLLOWING SEVERE TRAUMATIC BRAIN INJURY

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Prehospital intubation has been challenged as it may predispose to hyperventilation, which is detrimental following traumatic brain injury (TBI), and impair venous return in patients with hypovolemia. **Objective:** To determine the incidence of hyperventilation among a cohort of trauma patients undergoing prehospital intubation and the impact of ventilation on outcome after severe TBI. **Methods:** Data were prospectively collected for all intubated trauma patients transported directly to our Level I center over 14 months (n=574). Patients with an ABG within 15 mins of arrival (n=490, 85%) were stratified based on initial pCO_2. Targeted ventilation was defined as pCO_2 30 to 35mmHg, based on previous prehospital studies. A pCO_2 < 30 mmHg was termed severe hypocapnea, a marker of hyperventilation. Patients with pCO_2 36-45 mmHg were considered mildly hypercapneic and >45 mmHg severely hypercapneic. **Results:** One third of patients were in the target ventilation range (Table). Women were more likely to be hyperventilated then men ($p<0.05$). Patients with severe hypercapnea (pCO_2 >45) had a higher ISS score and were more likely to be hypotensive, hypoxic and acidotic ($p<0.05$). Hyperventilated patients were less likely to be hypoxic (4% vs 7 % in target range, 14% for mild hypercapnea and 46% for severe hypercapnea). TBI patients (Head AIS >3) outside the target ventilation range had a higher mortality (OR 2.14, 95% CI 1.13-4.0, p=0.02) compared to those in range. Even after excluding those with severe hypercapnea, there was a higher mortality out of the target range (OR 1.99, 95% CI 1.0-3.9, p=0.04). **Conclusion:** Targeted prehospital ventilation (pCO_2 30 –35mmHG) is associated with lower mortality after severe TBI. Further studies to correlate these results with end-tidal CO_2 monitoring may guide prehospital ventilation strategies for these patients.

Arrival pCO2 (mmHg)	All intubated pts (N=490)	Head AIS>3 (N=216)	Mortality (All) (N=490)	Mortality (Head AIS>3) (N=216)
<30	83 (17%)	39 (18%)	100 (21%)	99 (34%)
30-35	151 (31%)	69 (32%)	88 (18%)	60 (28%)
36-45	187 (38%)	76 (35%)	137 (28%)	103 (48%)
>45	69 (14%)	32 (15%)	183 (37%)	111 (52%)

BEST PRACTICE DETERMINATION OF TIMING OF SPINAL FRACTURE FIXATION AS DEFINED BY ANALYSIS OF THE NATIONAL TRAUMA DATA BANK

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Introduction: To examine the efficacy of early vs. late spinal fracture fixation, we reviewed National Trauma Data Bank (NTDB) records to identify the breakpoint in timing of operative fixation. We then analyzed outcome for those treated early vs. late, hypothesizing that the early group would experience better outcome as reflected by resource utilization and complications. **Methods:** The NTDB was queried for patients with any spinal fracture that required surgical stabilization. Histogram analysis of the post-injury day of initial operative fixation was used to determine the point at which the majority of operative procedures had been performed, thereby defining early (E) and late (L) groups. Patients in E were matched to a cohort from L with similar age, ISS, and GCS. Outcome data included hospital length of stay (HLOS), intensive care unit length of stay (ICULOS), ventilator days (VENT DAYS), charges, incidence of complications, and mortality. Groups were compared using Student's T-test or Fisher's exact test, accepting $p \leq 0.05$ as significant. **Results:** Of 16,812 patients who underwent operative fixation, 59% were completed within 3 days of injury and formed E. The 374 L patients whose dataset

	AGE	GCS	ISS	HLOS*	ICULOS*	VENT ‡	CHARGES+
E	36.5 yrs	14.6	19.8	13.6 days	6 days	9.9 days	$87,433
L	40.9 yrs	14.2	20.5	24 days	9.3 days	11.5 days	$109,261
* $p < .0001$,‡$p = .49$, + $p < .03$							

was complete enough to allow analysis were matched to 497 E patients (Table). There was no significant difference in the presence of spinal cord injury between E and L (51 vs. 55%; p=0.21). Complications were significantly higher in L (30 vs. 17.5 %; $p<0.0001$) yet mortality was similar in both groups (2.0 vs.1.9%; $p>0.05$).**Conclusions:** NTDB records indicate that the majority of patients with spinal fractures undergo operative fixation within 3 days, and that these patients had less complications and required less resources. Use of a national data bank to compare groups with similar injury severity and presenting physiology can validate best practice and define opportunities for improvement in care.

FLUID RESTRICTION IN NOVEL CLINICALLY-RELEVANT MODEL OF POLYTRAUMA

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Introduction: Trauma patients frequently suffer multiple severe injuries and hemorrhagic shock is less common, but most models include the opposite pattern. We developed a new model to test the hypothesis that cerebrovascular function is improved with IVF restriction. **Methods:** Anesthetized, swine (40-60 kg, n=33) received severe closed head injury, bilateral lung contusions and hypoventilation for 30 min. For 15 min, "prehospital" resuscitation in the control group (n=5) was ventilatory support and 1L of normal saline (NS). For 15-90 min, additional NS maintained mean arterial pressure (MAP)>60 mmHg (ER phase). After 90 min (ICU phase), mannitol, phenylephrine, plus additional NS were titrated to cerebral perfusion pressure (CPP)>70 mmHg at a filling pressure >12 mmHg. Group 2 (n=5) received NS to the same MAP and CPP targets, but filling pressure was 8 mmHg. Group 3 (n=5) received Hextend, instead of NS, to group 2 targets. Group 4 (n=5) received minimal NS and phenylephrine to the same MAP and CPP targets. **Results:** All groups were similar in baseline conditions. At 30 min after injury, MAP=55-60 mmHg, HR>100 b/min, PaO_2<50 mmHg, $PaCO_2$>60 mmHg, and Lactate >5 mM. Upon resuscitation, these variables, as well as CPP, mixed venous O_2, gastric and portal venous O_2, cardiac output, and renal blood flow corrected in all groups. However after 4 hours,

Group	Brain PO_2 (mmHg)	IVF (mL/kg)	UO (mL/kg)	Hct	ICP (mmHg)	BIS (units)	SR ratio (% time)
Control	21 ± 7	163 ± 4	56 ± 9	24 ± 1	38 ± 4	35 ± 15	46 ± 20
2	22 ± 5	93 ± 27*	39 ± 6	29 ± 1	26 ± 4*	58 ± 12	17 ± 12
3	28 ± 6	57 ± 10*	31 ± 7*	25 ± 2	14 ± 2*	62 ± 4	0 ± 0*
4	6 ± 1*	43 ± 2*	32 ± 6*	31 ± 2*	22 ± 4*	52 ± 13	19 ± 19

*p<0.05 vs. control; UO=urine output; BIS=bispectral EEG index; SR=BIS suppression ratio

Conclusion: In a new, clinically-relevant polytrauma simulation, the sequelae of severe TBI were attenuated when IVF was restricted, especially with Hextend, even at the same standard resuscitation endpoints.

The epidemiology of Pelvic Ring Fractures: The Whole Picture

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BACKGROUND: Epidemiological studies on pelvic ring fractures (PRF) are predominantly retrospective; describing only high-energy PRF. Patients with low-energy PRF and those who die during the prehospital phase (pre-H) are invisible to trauma registries. *The aim of this study* was to comprehensively describe the epidemiology of PRF. **METHODS:** 12-month prospective cross-sectional epidemiological study was performed in an inclusive trauma system with one Level-1 trauma center (PRF management guidelines including angiography and emergency fixation in place) and seven referring hospitals (population: 0.6 million, area: 12,000 sqmiles). Data were collected on all PRF from the trauma system including high-energy, low energy fractures and pre-H deaths with PRF. Patient demographics, injury severity score (ISS), Tile classification (reported as % of total: Tile% A/B/C), mortality (%) and length of stay (LOS, days) were recorded prospectively. All high-energy deaths had autopsy at the same forensic pathology department. Data presented as percentages (%) or mean ±SEM. **RESULTS:** During the 12-month period 138 patients suffered PRF. Eighteen (13%) patients died pre-H (62% of the total deaths). PRF-related mortality was always due to bleeding. Sixty-four % of the low-energy and 92% of the high-energy patients were transferred directly to the trauma center.

	N#	Male	Age yrs	ISS	A/B/C%	LOS dys	Mortality	PRF-relat
All	138	45%	59±2	20±2	61/26/13	10±1	21%	8%
High-Energy	57	71%	41±3	23±3	41/41/18	15±3	14%	7%
Low-Energy	63	20%	81±1	6±1	98/2/0	8±1	5%	2%
Pre-H Death	18	47%	41±6	61±4	0/53/47	0	100%	33%

CONCLUSIONS: The majority of PRF-related mortality occurs pre-H with the highest incidence of C-type fractures. Half of the multiple-injured high-energy PRF patients still die because of the pelvic bleeding. Further preventive measures and optimization of the care of PRF patients is required. Primary trauma center admission of 2/3 of the low-energy PRF is a significant load and should be further investigated in an inclusive trauma system.

WILLIAM T. "BILLY" FITTS, JR., MD: AN AAST VISIONARY

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In 1974 the AAST memorialized William T. Fitts, Jr., MD, by establishing an annual lectureship in his name. We present a biographical sketch of Dr. Fitts, an individualistic and pioneering surgeon who helped shape the specialty of trauma.

"Billy" Fitts was born in 1915 in Jackson, Tennessee. He graduated from Union University in Jackson. In 1940 he received his MD from the University of Pennsylvania, graduating first in his class. He remained at Penn to train under I.S. Ravdin. In May 1942 Fitts joined Ravdin at the 20th General Hospital in Assam, India, near Burma. Established and manned by Penn faculty, the hospital eventually admitted 73,000 patients. The Burma years gave him expertise in fracture treatment, cemented the importance of the surgeon in trauma care, and fueled Fitts's interest in trauma care. After residency, Fitts joined the Penn faculty (Penn's first "trauma" surgeon), rising to Division Chief then to the John Rhea Barton Chair of the Department (1972-1975). Deeply devoted to the AAST, he served it as Secretary (1957-62), Vice-president (1963), and President (1965). He was instrumental in establishing the *Journal of Trauma* and served as its second editor, increasing the journal's circulation and influence. He had formative roles in the American College of Surgeons Committee on Trauma and the American Trauma Society (and was a President of ATS).

Nearly half of Fitts's 150+ papers were trauma-related. He contributed seminal works on acute trauma care, trauma epidemiology, access to trauma care, and causes of death after injury, addressing preventability. With Oscar Hampton, he helped set standards of care for fracture management. Fitts advocated the team approach to trauma care (led by the trauma surgeon) and foresaw trauma manpower issues decades ago. Fitt's palpable enthusiasm for trauma care inspired a generation of Penn residents. This remarkable man died in June 1980, leaving an inspirational legacy. His contributions have advanced trauma care and presaged many of our present challenges.

NEAR-INFRARED SPECTROSCOPY PREDICTS ORGAN DYSFUNCTION IN TRAUMA PATIENTS WITH SHOCK: A PROSPECTIVE COHORT STUDY

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Introduction: Near-infrared spectroscopy (NIRS) can continuously and non-invasively monitor tissue oxygen saturation (StO_2) in muscle and may be an index of shock severity. Our purpose was to evaluate how well StO_2 predicted outcome in high risk torso trauma patients presenting in shock who required early blood transfusion. **Methods**: The primary outcome in this prospective study was prediction of MODS (multiorgan dysfunction score ?6, after 3 days). StO_2 data were obtained upon admission and for 24 hours with other known predictors of hypoperfusion and clinical outcomes. Clinicians were blinded to StO_2 measurements. **Results**: 7 Level I trauma centers enrolled 203 evaluable patients, and 18 (9%) developed MODS. Cumulative Ischemia Score for StO_2 (CISS) was used as an index of hypoperfusion. CISS computes the magnitude and duration StO2 values measured <70% within a given time interval. CISS and highest base deficit (BD) were significant predictors of MODS.

	MODS	1h	2h	4h	6h
CISS	**No**	7.0±7.6	17.4±17.0	36.9±36.8	57.7±54.8
	Yes	4.7±7.7	6.6±19.8*	8.4±47.3*#	10.1±77.0*#
BD	**No**	7.8±4.6	8.3±4.9	8.5±4.9	8.5±5.0
	Yes	10.3±5.5*	11.0±5.9*	11.2±5.7*	11.9±5.7*#

Values are means±SD. * $p<0.05$, #$p<0.01$ by Student's t-tests.

Conclusions: NIRS-derived muscle tissue oxygen saturation performs similar to base deficit in identifying poor perfusion and predicting the development of MODS after severe torso trauma, yet has the additional advantages of continuous, non-invasive monitoring.

SERUM B-TYPE NATRIURETIC PEPTIDE: A MARKER OF FLUID RESUSCITATION AFTER INJURY?

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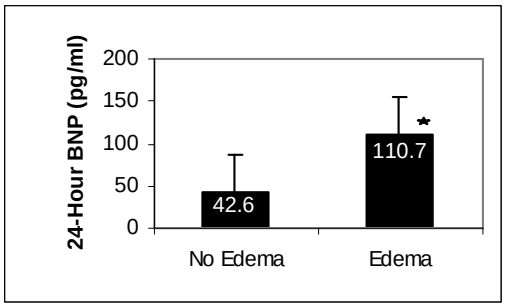
OBJECTIVES: Excessive volume resuscitation after injury has been associated with severe complications such as abdominal compartment syndrome. B-type natriuretic peptide (BNP) is secreted from myocardium under increased wall stress and is used in medical intensive care units (ICU) as a non-invasive method to detect fluid overload. However, the use of BNP as a marker of fluid overload during resuscitation from injury has not been described. We hypothesized that serum BNP increases during resuscitation and is associated with radiographic findings of fluid overload. **METHODS**: BNP levels were prospectively followed in 134 trauma ICU patients. Levels were obtained on admission as well as 12, 24, and 48 hours. Repeated measures ANOVA was used to test for differences in BNP levels over time. Chest films were obtained at 24 hours and scored for the presence of pulmonary edema by a blinded radiologist (n=45). 24-hour BNP levels for patients with or without radiographic evidence of pulmonary edema were compared (Mann-Whitney U). **RESULTS:** Admission BNP levels were low and increased with resuscitation over time (Table). At 24 hours, 25 patients (55%) had no pulmonary edema on CXR, while 20 (44%) were scored with edema. Patients with evidence of pulmonary edema on CXR had higher BNP levels at 24 hours than patients without edema (*p=0.05) (Figure). **CONCLUSIONS:** Serum BNP increases with resuscitation after injury and levels are higher in patients who develop pulmonary edema. These findings suggest that BNP may be a marker of excessive volume resuscitation after injury.

Time Point	BNP (pg/ml) (mean±SD)	p value*
Admission	23.8±37.8	baseline
12 Hour	53.2±65.7	<0.001
24 Hour	83.9±106	<0.001
48 Hour	86.8±119	<0.001

*Compared to baseline



BETA-BLOCKER USE IS ASSOCIATED WITH IMPROVED OUTCOMES IN ADULT TRAUMA PATIENTS

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Background: Since Beta-blockers (βB) may lower the cerebral perfusion pressure, there is concern regarding their use in trauma patients with head injury. However, βB may be beneficial by decreasing oxygen consumption of beta-receptor rich brain cells and hypermetabolism. We hypothesized that βBs are safe in trauma patients, even if they have suffered a significant head injury. Methods: Using pharmacy and trauma registry data of a level I trauma center we identified a cohort of trauma patients who received βBs during their hospital stay (2001-2004). Trauma patients admitted during this period who did not receive βBs were in the control cohort. βB status, in combination with other variables associated with mortality, was placed in a stepwise multivariate logistic regression to identify independent predictors of fatal outcome. Results: 303 (7%) of 4,117 trauma patients received βBs. The most common reason to initiate βB therapy in the hospital was blood pressure (54%) and heart rate (21%) control. The overall mortality rate was 6% or 230 patients. Head injury was considered to be the main cause of death in 53% and cardiac complication was a significant factor in 9% of the deaths. After adjusting for age, ISS, blood pressure, GCS, respiratory status, and mechanism of injury, the odds ratio (OR) for fatal outcome was 0.3 ($p<0.001$) for βB patients. This decrease in the risk of fatal outcome with βBs was mainly seen in patients who were admitted with a significant head injury and GCS<14 (OR 0.2, $p<0.001$) versus patients who had GCS 14-15 (OR 0.5, $p=0.2$). These results remained true even if patients with hypotension were excluded from the analyses (data not shown). Conclusions: In our study, βB therapy was associated with improved outcomes in trauma patients with head injury. Considering the limitation of this study, we conclude that βBs are safe in trauma patients. Further studies on βB therapy in trauma patients with head injury and their effect on CNS oxygen consumption are warranted.

BETA-BLOCKER EXPOSURE IS ASSOCIATED WITH IMPROVED SURVIVAL FOLLOWING SEVERE TRAUMATIC BRAIN INJURY

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Introduction: The use of beta-blockers in elective non-cardiac surgery has been associated with reduced mortality and incidence of cardiovascular complications. Severe traumatic brain injury (TBI) is frequently associated with a hyper-adrenergic state. We hypothesized that adrenergic blockade would confer improved survival among TBI patients.

Methods: All trauma patients admitted from 01/2004-01/2005 with head AIS or 3 or greater were evaluated. We excluded all patients with a LOS < 4 days. Beta-blocker exposure was defined as receiving beta-blockers for 2 or more consecutive days. Data was then evaluated using Fischer's exact and Wilcoxon rank sum.

Results: 420 patients met inclusion criteria. 174 patients were defined as exposure, BB (+), and 246 as no exposure, BB (-).

	BB (+), n=174	BB (-), n=246	p-value
ISS, mean	33.5	30.7	0.01
TRISS	0.5903	0.7035	<0.001
Age in years , mean	50.0	36.3	<0.001
Mortality (%)	9 (5.17%)	27 (10.98%)	0.03

Conclusions: Among patients with severe TBI, beta-blocker exposure was associated with a significant reduction in mortality. This reduction in mortality is even more impressive, considering that the BB (+) group was older, more severely injured, and had lower predicted survival by TRISS methodology.

EARLY COAGULOPATHY AFTER TRAUMATIC BRAIN INJURY: THE ROLE OF HYPOPERFUSION AND THE PROTEIN C PATHWAY

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Introduction: Early coagulopathy after traumatic brain injury (TBI) is thought to be the result of injury-mediated local release of tissue factor, although the precise mechanisms that cause hypoperfusion and early systemic coagulopathy in TBI patients are unknown. We have previously reported that early systemic coagulopathy after trauma is only present when tissue injury is associated with severe hypoperfusion leading to the activation of the protein C pathway. However, the role of hypoperfusion as an important mechanism for the development of coagulopathy early after TBI is unclear. The objective of the present study was to determine the importance of hypoperfusion and protein C activation in causing early coagulopathy in TBI patients. **Materials and methods:** We performed a prospective cohort study including patients with isolated brain injury admitted to a single trauma center. Blood was drawn within 10 minutes of arrival in the ED. Plasma samples were assayed for protein C, and thrombomodulin (TM) by standard laboratory techniques. Routine coagulation measures (PT, PTT) and arterial blood gas analysis were performed concurrently. Severe hypoperfusion was evidenced by the presence of an arterial base deficit greater than 6. **Results:** 39 TBI patients over a 15-month period were included in the study. TBI patients without concurrent hypoperfusion (n=28) did not develop an early coagulopathy after trauma. In contrast, patients with TBI who also had severe hypoperfusion (BD>6) (n=11) were coagulopathic early after injury. Indeed, these patients had higher PT and PTT compared to those with TBI and a BD < 6 (17.6 $\pm$ 3.6 vs. 14.3 $\pm$2.3, $p < .005$ and 43.13$\pm$18.3 vs. 27.4$\pm$3.8, $p < .0001$). Unactivated protein C levels were lower in the TBI BD>6 group (56$\pm$ 32 vs. 85$\pm$ 35 p=.03) and TM levels were significantly higher (48$\pm$26 vs. 35 $\pm$ 10 p=.04). **Conclusions**: TBI alone does not cause early coagulopathy, but must be coupled with hypoperfusion to lead to coagulation derangements, associated with the activation of the protein C pathway. This novel finding has significant implications for the treatment of coagulopathy after severe brain injury.

Osteoinductive potential of cerebrospinal fluid from trauma patients

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Background: Clinical studies have demonstrated enhanced fracture healing and heterotopic ossification in traumatic brain injured (TBI) patients. It is hypothesized that the injured central nervous system releases osteoinductive factors. To date, little is known about the presence of these factors in human CSF.

Objective: To investigate whether cerebrospinal fluid (CSF) of TBI patients is osteoinductive in a human *in vitro* model. Additionally, S100B and BMP-2, -4, and -7 were investigated as putative factors of osteoinduction.

Methods: CSF samples from 84 consecutive patients were tested. A human *in vitro* model of osteoinduction was established using a characterized fetal human osteoblast cell line (hFOB). All experiments were performed blinded to the patient's diagnosis. CSF-induced hFOB proliferation was repeatedly measured using CellTiter96. Proliferation rates were calculated and normalized as a percentage of the internal plate control. The patients were categorized into three groups after experimentation: TBI (n=11), non-traumatic brain pathology (NTBP) (n=26), and no brain pathology (control group) (n=47). Statistical analysis was performed using SPSS 13.0 for Windows.

Results: The mean proliferation rate was 94.7% (SD 18.5) for the TBI, 74.5% (SD 14.4) for the NTBP, and 84.7% (SD 17.9) for the control group. The TBI group had a significantly higher mean rate of proliferation than the NTBP group (P=0.004), and the NTBP group had a lower mean than the control group (P=0.042). The mean CSF S100B concentration was 5.08 µg/L (range 1.0 - 18.0 µg/L). BMP concentrations revealed only 3 (of 36) measurable values, which were just above the minimal detectable concentration. There was no correlation between S100B or BMP-2, -4, or -7 levels and proliferation rates.

Conclusion: The results clearly indicate that CSF from TBI patients has an osteoinductive effect *in vitro*. It is unlikely that S100B or BMP-2, -4, or -7 are the agents responsible for this effect.

CARDIAC UNCOUPLING & HEART RATE VARIABILITY HERALD INTRACRANIAL HYPERTENSION: A STUDY OF 143 TRAUMA PATIENTS WITH CONTINUOUS MONITORING AND DENSE DATA CAPTURE.

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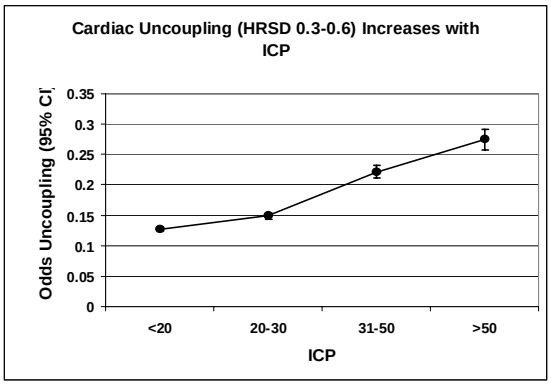
Introduction: A non-invasive tool reflecting intracranial hypertension (ICH) should prompt early invasive monitoring & reduce secondary injury in head trauma patients. We hypothesize an association between cardiac uncoupling (low heart rate variability, HRV) & ICH.

Methods: Of 14,330 consecutive trauma admissions, 145 had simultaneous HRV & intracranial pressure (ICP) monitoring. ICP and heart rate (HR) data were matched & divided into 5-minute intervals (N=117,981 representing 24.4 million HR and ICP data points). In each interval, the median ICP, the intra-percentile range (90^{th}-10^{th} percentile of HR in the 5-minute interval) & standard deviation of HR (HRSD5) were calculated. Cardiac uncoupling was defined as an interval with HRSD5 between 0.3 & 0.6 bpm.



Wilcoxon rank-sum test compared cardiac uncoupling between ICP categories.

R**esults**: Cardiac uncoupling increases as ICP increases (P< .001). The odds of cardiac uncoupling nearly double when comparing normal ICP (<20; 0.13) to clearly abnormal ICP (31-50; 0.22), & the trend continues in the highest ICP category (>50; 0.28). The trend in odds is significant (P<.001) by the score test for trend in odds. Linear regression demonstrates a linear relationship between the percent of time uncoupled & the maximum ICP, 95%ile (P<.001).

Conclusion: HRV and Cardiac Uncoupling:

1) Identify patients at risk for intracranial hypertension,

2) Are temporally associated with, and may herald changes in intracranial pressure,

3) May be a non-invasive tool to identify patients benefiting from intracranial monitoring.

IMPACT OF DELAYED INITIATION OF VENOUS THROMBOEMBOLISM PROPHYLAXIS IN THE TRAUMA ICU

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Purpose: The incidence of VTE without prophylaxis is as high as 80% after major trauma in the absence of pharmacologic prophylaxis (PROPH). Initiation of PROPH is often delayed due to concerns of injury-associated bleeding. As the impact of delays in beginning PROPH on the rate of VTE is unknown, we set out to evaluate the relationship between late initiation of PROPH and VTE .

Methods: Data were derived from a multicenter prospective cohort study evaluating clinical outcomes in adults with hemorrhagic shock due to injury. Analyses were limited to patients with an ICU length of stay $\geq$7 d. The principal objectives were to describe the practice of VTE prophylaxis (pharmacologic or IVC filter) over the first week following injury and to evaluate the relationship between clinical practice and VTE.

Results: 318 subjects met inclusion criteria. 38 VTE occurred in 34 patients (10.7%): 14 PE, 16 DVT, 4 DVT and PE. 35% of VTE were diagnosed within the first 7 d. The mean proportion of days over the first week without any prophylaxis was 50$\pm$32% and almost half (45%) had not had PROPH begun within the first 4 d. Only 37 (12%) of patients had a filter placed within the first week.

Days post injury	PROPH N (%)	Relative odds of VTE (95% CI)
0-2 d	82 (26)	Reference
3-4 d	93 (29)	1.3 (0.37-4.9)
5-7 d	60 (19)	3.9 (1.2-13)
>7 d	83 (26)	4.0 (1.2-13)

The odds of VTE, at any time, increased almost 4 fold if PROPH was initiated beyond 4 d (Table).

Conclusions: Clinicians are reticent to begin timely PROPH in critically injured patients. Patients have no protection (pharmacologic or mechanical) from VTE for half of all days within the first week of admission. Delayed initiation of PROPH (>4 d) is associated with a 4 x greater risk of VTE. The relative risks and benefits of early VTE prophylaxis need to be defined to better direct practice in this high risk population.

HSPTX ATTENUATES GUT INJURY AFTER HEMORHAGIC SHOCK: THE KINDER, GENTLER RESUSCITATION

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Introduction: The production of reactive oxygen species and pro-inflammatory mediators in the gut during ischemia-reperfusion injury has been implicated in distant neutrophil activation and acute lung injury (ALI). We have previously demonstrated attenuation of ALI and histologic gut injury when hypertonic saline and PTX (HSPTX) were utilized in post-shock resuscitation. We hypothesized that HSPTX would attenuate gut pro-inflammatory mediator synthesis and oxidative stress through downregulation of NFκB-dependent iNOS production.

Methods: In a standard rat model of hemorrhagic shock, animals were resuscitated with RL (32 ml/kg) or HSPTX (4 ml/kg 7.5% NaCl + PTX 25 mg/kg). Sham animals that did not undergo shock were used as a negative control. Four hours after resuscitation, terminal ileum was collected. TNF-α and IL-8 were measured with ELISA. Nitrite and nitrotyrosine levels were measured with commercially available kits. HO-1, iNOS, NFκB p65 nuclear translocation, and IκB phosphorylation were determined by Western blot.

Results: HSPTX administration led to a 56% ($p<0.009$) and 89% ($p<0.0001$) decrease in IL-8 and TNF-α levels respectively when compared to their RL-treated counterparts. A significant decline of 62% in HO-1, a marker of oxidative stress, was observed in HSPTX resuscitated animals ($p<0.001$). RL-induced iNOS expression was increased 49% over HSPTX-treated animals ($p=0.006$). Comparable results were observed between groups when nitrite and nitrotyrosine concentrations were measured. Upregulation of NFκB p65 and IκB phosphorylation observed with RL infusion was not seen with HSPTX.

Conclusion: HSPTX reduces resuscitation-induced gut injury when compared to RL through attenuation of oxidative stress, as evidenced by diminished HO-1, iNOS, nitrite and nitrotyrosine concentrations. These beneficial effects are likely due to attenuation of an NFκB-dependent mechanism. Therefore, HSPTX has the potential to be a superior resuscitation fluid with significant immunomodulatory properties.

Ischemia Reperfusion Induces Postcapillary Fluid Leak in Two Phases that are Temporally and Mechanistically Independent

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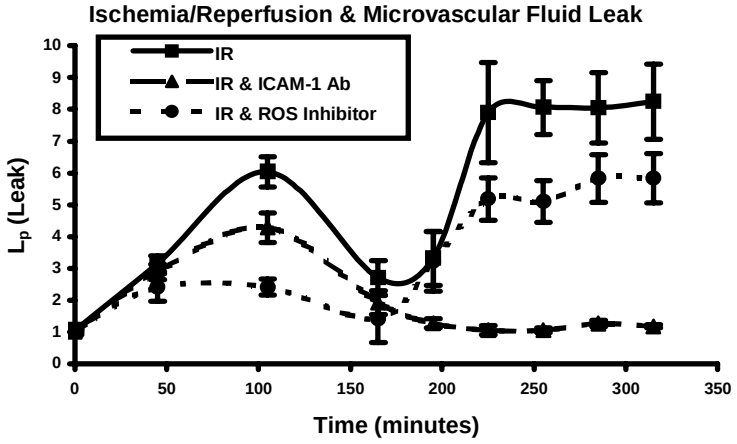
Introduction: Ischemia reperfusion (IR) injury occurs in postcapillary venules. We hypothesized that IR induces a biphasic increase in postcapillary fluid leak with early reactive oxygen species (ROS) and late white blood cell (WBC) mediated peaks in leak.

Methods: A micro-cannulation technique determined postcapillary fluid leak (L_p) in rat mesenteric post-capillary venules serially throughout ischemia (45 min) and reperfusion (4 hrs) induced by superior mesenteric artery occlusion and release. WBC adhesion was quantified. Additional animals were fed a tungsten diet to inhibit ROS synthesis and then underwent IR. Furthermore, an ICAM-1 antibody was used to interrogate the effect of WBC adhesion.

Results: Mesenteric IR resulted in a biphasic increase in leak. WBC adhesion slowly increased with maximal adhesion corresponding to the second peak of fluid leak ($p<0.005$). ROS inhibition dramatically attenuated fluid leak during the first peak and mildly decreased the second peak ($p<0.005$). ICAM-1 inhibition mildly attenuated fluid leak during the first peak and completely blocked the second peak ($p<0.005$).



Conclusions: IR induces a biphasic increase in fluid leak. The first peak is transient, ROS dependent, and WBC adhesion independent. The second peak is sustained and WBC-endothelial cell adhesion dependent. These serial measurements of postcapillary fluid leak may the way for optimal timing of pharmaceutical therapies in IR injury.

POLOXAMER 188 ABROGATES NEUTROPHIL MEDIATED MESENTERIC ISCHEMIA/REPERFUSION ILEAL MUCOSAL INJURY

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Introduction: Mesenteric ischemia/reperfusion promotes neutrophil (PMN) activation which results in end organ injury. Poloxamer 188 (P188), a nonionic block polymer surfactant, inhibits neutrophil activation and neutrophil migration into tissues. We hypothesized that Poloxamer 188 resuscitation after mesenteric ischemia/reperfusion will attenuate mucosal injury.

Methods: Rats were assigned to Sham/No Res, Sham/4cc/kg P188, SMAO/No Res, SMAO/4cc/kg 0.9% NS or SMAO/4cc/kg P188. All animals underwent internal jugular line placement and midline celiotomy. SMAO clamps were placed in the assigned groups for 60 minutes and Res was given 5 minutes prior to clamp removal. Animals were sacrificed at 6 hours of reperfusion and ileum was harvested for analysis. PMN influx was assessed by measuring myeloperoxidase (MPO) protein expression and histological injury was quantitated by the Chiu score (0-5). Data are reported as mean ± SEM (n = 6/group; ANOVA). Means with different letters are significantly different.

Model	Neutrophil Influx (MPO) (ng/mg)	Mucosal Injury (Chiu Score)
Sham/No Res	2.04 ± 0.18 a	0.57 ± 0.20 a
Sham/4cc/kg P188	2.42 ± 0.14 a	0.33 ± 0.21 a
SMAO/No Res	4.97 ± 0.45 b	4.33 ± 0.33 b
SMAO/4cc/kg 0.9% NS	4.50 ± 0.23 b	2.66 ± 0.33 c
SMAO/4cc/kg P188	3.15 ± 0.25 c	1.16 ± 0.16 a

Results: SMAO/No Res significantly increased ileal MPO and mucosal injury. NS Res had little effect on MPO and slightly improved mucosal injury. However, P188 Res significantly attenuated ileal MPO and mucosal injury.

Conclusion: Poloxamer 188 attenuated neutrophil influx and provided ileal protection against mesenteric/ischemia reperfusion neutrophil mediated injury. This protective effect may provide protection against shock induced end organ injury and multiple organ failure.

HEMATOPOIETIC PROGENITOR CELLS MOBILIZE TO THE SITE OF INJURY FOLLOWING TRAUMA/HEMORRHAGIC SHOCK IN RATS

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Background: We have previously shown that Trauma/Hemorrhagic Shock (T/HS) results in both bone marrow (BM) suppression and the release of hematopoietic progenitor cells into peripheral blood. These cells have also been identified in numerous end-organs following T/HS however their effects are unknown. We hypothesized that following trauma, hematopoietic progenitor cells migrate to sites of injury and that this process is enhanced following hemorrhagic shock. **Methods:** Sprague-Dawley rats (250-400g) sustained a unilateral lung contusion using the blast wave of a percussive nail gun (Craftsman 968514 Stapler) applied to a small metal plate onto the right chest. The rats were then subjected to either hemorrhagic shock (HS) (MAP 40-45 mmHg for 45 min) or sham shock (SS) (n= 4/group). The right and left lungs from each animal were processed separately and the unmanipulated left lung served as control for comparison with the contused right lung. BM mononuclear cells from each individual lung and the femurs were isolated and plated (2×10^6) in duplicate for progenitor cell colonies. **Results:** The contused right lung was found to have a greater number of BM cell colonies when compared to the left unmanipulated lung. Hemorrhagic shock significantly increased the number of colonies in both the unmanipulated and contused lungs with the greatest increase appearing in the HS contused lung group. (Table)

Lung Group	**Sham Shock**		**Hemorrhagic Shock**	
Colonies/ Plate	**Unmanipulated** (left lung)	**Contused** (right lung)	**Unmanipulated** (left lung)	**Contused** (right lung)
CFU-GM	4.9 ± 1.9	10.9 ± 0.6	15.1 ± 5.0	30.9 ± 7.6
CFU-E	3.0 ± 1.3	12.4 ± 2.1	8.6 ± 3.2	31.0 ± 6.3
BFU-E	3.0 ± 1.2	6.5 ± 1.4	8.63 ± 2.1	19.5 ± 2.1

* $p < 0.05$ (unmanipulated SS lung vs. contused SS lung), ** $p <$ (contused SS lung vs. contused HS lung)

Conclusion: Unilateral lung contusion results in the mobilization of a significant number of hematopoietic progenitor cells to the site of injury and the addition of HS has a synergistic effect on this process. The exact role and fate of these cells at the site of injury as well as their effect on BM suppression needs further investigation.

INFLUENCE OF THERAPY WITH FTY720 ON SURVIVAL, NEUTROPHIL INFILTRATION AND CYTOKINE PRODUCTION AFTER EXPERIMENTAL ISCHEMIA OF THE LOWER EXTREMITY

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Introduction: Ischemia and reperfusion (I/R) damage is a complex process involving diverse mechanisms including adhesion and transmigration of lymphocytes and neutrophilic granulocytes and generation of reactive oxygen metabolites such as free radicals. In posttraumatic ischemic damage the adherence of leukocytes to endothelial cells lead to the release of oxygen radicals and proteases. Damage of the endothelium layer increased capillary permeability which results in interstitial edema. FTY720 is an immunsuppressive agent that reduces neutrophils and monocytes in peripheral blood as well as lymphocyte infiltration. This study investigated the effect of FTY720 during I/R.

Methods: Male C57BL/6 mice underwent temporary ligation of the infrarenal aorta for 4 hours. After reperfusion for 48 hours they were sacrificed by exsanguination. After alveolar lavage lungs, kidneys and livers were snap frozen. Tissue myeloperoxidase (MPO) content reflecting neutrophil infiltration of the lung, muscle and liver was determined. RT-PCR analysis of local cytokine transcription in all tissues were performed as well.

Results: Treatment with FTY720 lead to lower mortality rate (11,1 % vs. 75 %, $p<0.05$). Downregulation of IL-1 was detected in the liver (0.09 ± 0.04 vs. 0.30 ± 0.10; $p< 0.05$) and kidney (0.08 ± 0.03 vs. 0.37 ± 0.18, $p<0.05$), but not in the lungs. The anti-inflammatory cytokine IL-10 was upregulated in the liver (0.18 ± 0.03 vs. 0.04 ± 0.01, $p<0.05$). No changes were seen in MPO content after treatment with FTY720.

Discussion. In this experimental model of I/R damage treatment with FTY720 leads to a higher survival rate compared to vehicle treatment. While neutrophil infiltration was not affected by treatment with FTY720, intrinsic cells appear to be involved in changes of cytokine production in different organs.

MISMATCH RECOVERY OF REGIONAL CEREBRAL BLOOD FLOW AND BRAIN TEMPERATURE DURING REPERFUSION AFTER THE PROLONGED BRAIN ISCHEMIA IN GERBILS

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Objective: We aimed to clarify differences in the post-ischemic recovery of physiological parameters between short and prolonged brain ischemia.

Methods:18 male mongolian gerbils(50 ~ 60 g) were divided into the three groups, 5minuets(G5), 15minuets(G15) and 30minuets(G30) ischemia groups. Under anesthesia, bilateral common carotid arteries were isolated and a craniotomy was performed. Using a microspectroscopy system, consisted of an intravital microscope, a charge-coupled device (CCD) camera and laser Doppler flowmeter, we measured changes in regional Cerebral blood flow(r-CBF), in microvessel diameter and in brain temperature(BrT) spontaneously. We also measured somatosensory evoked potential(SEP) to evaluate electrophysiological function.

Results:In G5 and G15, r-CBF and microvessle dilatation showed peaks at 10 ~ 15minuets ,but in G30, neither of r-CBF and microvessle dilatation made such transient peak. The rise of the BrT in G5 and G15 was less than 1 centigrade at 10 ~ 15minuets after reperfusion, whereas that in G30 significantly rose more than 2 centigrade. SEP recovered with increase of r-CBF at the same time, in G5 and G15. However, in G30, SEP recovered with a delay from increase of r-CBF, and disappeared lately. Almost all the G30 gerbils died within 24 hours, but G5 and G15 were all alive.

Conclusion: We conclude that the mismatch recovery of r-CBF and brain temperature would be deleterious to the brain tissue, during reperfusion after the prolonged brain ischemia group.

r-CBF	Pre	Ischemia	15min	30min	60min	**BrT**	Pre	Ischemia	15min	30min	60min
G5	100	27± 4.1	193± 4.1	91± 4.5	74± 4.5 (%)		0	-0.2+0.08	0.53+0.1	0.62+0.2	0.27+0.07(℃)
G15	100	18± 5.0	178± 14	103± 8.0	70± 4.9 (%)		0	-1.0+0.9	0.66+0.2	0.44+ 0.09	0.01+0.1 (℃)
G30	100	17± 2.9	*84± 8.5	109± 8.0	62± 4.7 (%)		0	-0.93+0.1	*2.5+0.4	2.0+0.23	1.1+0.2 (℃)

(r-CBF: %baseline, BrT: difference from baseline MEAN± SEM) *p<0.05 vs.G5,G15

HEPATOPROTECTION AND LETHALITY RESCUE BY THE HISTONE DEACETYLASE INHIBITOR VALPROIC ACID.

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Background: Pharmacological histone deacetylase inhibitors (HDACI) such as the anticonvulsant valproic acid (VPA) increase acetylation of nuclear histones, promoting transcriptional activation of deregulated genes and demonstrate cytoprotection. Therefore, we examined protective effects of VPA administration in lethal hemorrhage and analyzed the patterns of hepatic histone acetylation. **Methods:** Male Wistar Kyoto rats were pretreated with VPA (n=10) and 2-methyl-2- pentenoic acid, a structural VPA analogue with limited HDAC inhibiting activity (2M2P; n=8), at 300mg/kg/dose, administered subcutaneously, 24h and immediately before lethal, if untreated, hemorrhage (60% of total blood volume). Both drugs were dissolved in normal saline (NS). Control rats were pretreated with corresponding volume of NS (n=8). Time to death, the degree of histone acetylation, HDAC activity and markers of cytotoxicity (alpha-glutathione S-transferase (α-GST), ALT, AST, LDH, and lactate) and apoptosis were analyzed. **Results:** VPA-pretreated animals demonstrated a five-fold increase in survival. At 12 hours post-hemorrhage, 70% (VPA) and 12% (2M2P) pre-treated rats were alive vs. 0% in NS group. Hyperacetylation of histones H2A, H3, and H4 indicated the presence of active genes and correlated with survival (VPA>2M2P>NS). Hemorrhage-induced increases in lactate, LDH, AST and ALT were alleviated by VPA. Moreover, α-GST release, indicative of liver damage, was completely abolished.

Conclusion: VPA increases survival and offers considerable hepatoprotection in severe hemorrhagic shock. The role of HDAC inhibition is suggested in mediating pro-survival actions of VPA.

HO-1 Overexpression Significantly Reduces ROS Generation Following Hemorrhagic Shock

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Objective: Hemorrhagic shock (HS) results in microvascular injury from leukocyte adherence and the generation of reactive oxygen species (ROS). Heme-oxygenase-1 (HO-1) metabolizes heme, a potent cytotoxic agent, to carbon monoxide and biliverdin. HO-1 has been shown to protect the host by the product of it's by products, and anti-oxidant effect. We have been able to demonstrate that HO-1 overexpression ameliorates leukocyte adherence and vascular permeability following HS. We hypothesized that by increasing HO-1 expression; there would be a decrease in the generation of ROS following HS and resuscitation, suggesting a mechanism for the protective effects of HO-1.

Methods: Sprague-Dawley rats (300mg) were administered hemin (n=5) or vehicle (n=5) six hours prior to surgery. HO-1 expression was measured by RT-PCR in various tissues. Shock was induced in pentobarbital-anesthetized animals by decreasing MAP to 40mmHg for 60 minutes, followed by standard resuscitation measures. ROS generation was determined by the intravenous administration of Dihydrorhodamine 123 (DHR), which will increase in intensity in the vessel. This product is measured via intra-vital microcopy of rat mesenteric venules.

Results: Hemin administration significantly increased HO-1 expression. Fluorescence measurements inside the vessel, a direct measure of ROS, significantly decreased following hemin during the earliest measurement following resuscitation (60 minutes 208.67±5.53 vs. 149.14±5.53, $p<0.0001$) and continued to remain significant in difference through the span of the experiment (3 hours).

Conclusion: Hemin increased expression of HO-1 and resulted in significantly less ROS generation within the microvessels, following HS. This data suggests HO-1 may play a protective role against shock induced microvascular injury by decreasing ROS.

CLINICAL EXAM AND ITS RELIABILITY IN IDENTIFYING CERVICAL SPINE FRACTURES

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Hypothesis: Clinical examination (CE) is unreliable in diagnosing cervical spine (c-spine) fractures regardless of admission GCS. **Materials and Methods:** We prospectively evaluated 534 blunt trauma patients at our level I trauma center that were trauma team alerts. Positive CE was defined as: complaints of neck pain, external trauma of the c-spine or neurologic deficit, tenderness or abnormalities to palpation over the c-spine. Helical CT with reconstruction was used to define the accuracy of CE. **Results:** There were 52 patients with (Fracture group) and 482 patients without (No fracture group) c-spine fractures. The groups were similar in demographic data and mechanism (? 75% MVC).

All Patients	**+ CE**	**- CE**	**Total**	Sensitivity 76.9 %
Fracture by CT	40	12	52	Specificity 54.7%
No fracture by CT	218	264	482	Positive Predictive Value (PPV) 15.5 %
Total	256	278	534	Negative Predictive Value (NPV) 95.7 %

The results of all patients with a GCS of 15 are shown below.

Patients with GCS= 15	**+CE**	**-CE**	**Total**	Sensitivity 66.7 %
Fracture	16	8	24	Specificity 62 %
No Fracture	135	220	355	PPV 10.6 %
Total	149	230	379	NPV 96.5 %

The results of patients with a GCS=15, non-drunk, no distracting injuries are below.

GCS=15, non-drunk, no distracting injuries	**+CE**	**-CE**	**Total**	Sensitivity 58.8 %
Fracture	10	*7	17	Specificity 62.7 %
No Fracture	113	190	303	PPV 8.1 %
Total	121	199	320	NPV 96.5%

*Of the 7 missed injuries by exam, 3 were significant requiring intervention

Conclusions: Although a number of studies have been quoted to support clearing c-spines without films, none have been done prospectively in trauma alerted patients with CT as the gold standard. This trial demonstrates that with a normal GCS, CE cannot be relied upon to rule out c-spine fracture. Contrary to EAST guidelines, CE is unreliable to diagnose or exclude a cervical spine fracture.

Thromboembolic Event Prophylaxis: How Low Can We Go?

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Introduction: Thromboembolic events (TE), including deep venous thrombosis (DVT) and pulmonary embolism (PE), remain a potentially lethal complication in the care of the trauma patient. We have previously shown a decrease in TE rates for traumatically injured surgical ICU patients after introducing a standardized approach to DVT prophylaxis on the trauma service. We hypothesized that this approach would produce a sustainable decrease in TE, even after changing to a hospital wide prophylaxis form. **Methods:** We previously collected prospective data on all trauma patients after implementation of a DVT prophylaxis guideline. We continued data collection for an additional 18 months (1/04-6/05) after the original study. In July 2005, the hospital implemented a mandatory DVT prophylaxis guideline for all patients, which replaced our service specific protocol. We continued data collection after that change, which included DVT and PE rates as well as prophylaxis type and timing. **Results:** Most TE occurred in patients receiving appropriate prophylaxis or at risk for anticoagulation. The mandatory hospital wide guideline improved assessment to 99% of patients and decreased TE with inappropriate prophylaxis from 21% to 0%. TE rates initially improved but have not changed significantly over time. However, this may reflect more aggressive surveillance and detection in later time periods. SICU patients still have the highest risks of developing TE. **Conclusion:** TE prophylaxis guidelines, when used effectively, can minimize TE. Given the risks in trauma patients, TE rates will likely never be zero, but prophylaxis errors can be eliminated.

	2002	2003	2004	Jan –Jun 2005	July- Dec 2005
# Patients	1347	1184	1482	689	902
DVT Rate %	1.8	0.8	1.1	1.7	1.3
PE Rate %	0.6	0.3	1.2	0.3	0.9
TE (%)	26 (1.9)	12 (1.0)	31 (2.1)	14 (2.0)	19 (2.1)
TE SICU %	6.3	2.1 *	5.1	4.6	4.6
Errors (%)	NA	NA	7 (23)*	3 (21)*	0 (0)*

Errors: No drug or wrong dose in patients eligible for anticoagulation. * $p \leq .05$

WHAT IS THE ROLE FOR CHEST X-RAY IN THE INITIAL ASSESSMENT OF STABLE TRAUMA PATIENTS?

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***Background*:** The ATLS© course advocates the use of chest x-ray (CXR) during the initial evaluation of trauma patients. We reviewed CXR performed in the trauma resuscitation room (TR) in order to determine its usefulness.

***Methods*:** A retrospective registry-based review of 1000 consecutive trauma patients who underwent CXR in the TR at a Level I trauma center over a seven-month period was conducted.

***Results*:** Patients receiving CXR comprised 91.5% of all patients evaluated in the TR during the study period. CXR followed by chest CT (CCT) was performed in 820 (82.0%) patients. Subsequent CCT identified missed injuries in 235 (28.8%) of the 816 patients with an initial negative CXR. CXR alone was performed in 127 (26.1%) of the 487 patients who were stable, not intubated, and had a normal chest physical examination (CPE). Eight patients (6.3%) in this group had significant findings, however, none required intervention. CXR vs. CCT findings and rate of intervention in stable patients are detailed in this table:

CPE	Positive CXR Findings	Positive CCT Findings	Required Intervention
Abnormal: 373 patients	19.6%	49.6%	5.6%
Normal: 487 patients	9.4%	28.6%	0.4%

Three hundred and sixty (36.0%) hemodynamically stable patients with a normal CPE underwent both CXR and CCT. One hundred and sixteen patients (32.2%) in this group had findings of significance, and 2 (0.6%) required intervention. One patient received bilateral chest tubes for significant pre-existing pleural effusions found on CXR and CCT and another patient required a chest tube for a pneumothorax found only on CCT.

***Conclusion*:** In stable trauma patients with a normal CPE, CXR appears to be unnecessary in their initial evaluation. This is particularly true when CCT is combined with CT scan of the abdomen and pelvis in the evaluation of torso trauma. CXR should be relegated to a role similar to cervical spine and pelvis radiographs in the initial evaluation of hemodynamically stable trauma patients with a normal physical examination.

PARADIGM SHIFT IN THE MANAGEMENT OF BLUNT AND PENETRATING INJURIES TO THE THORACIC AORTA: A SINGLE CENTER EXPERIENCE

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Purpose Review the change in the management of blunt and penetrating injuries to the thoracic aorta at a single medical center in a large metropolitan area.

Methods From 2002 to 2005 patients with a suspected blunt (Group I) or penetrating trauma (Group II) to the aorta were identified. Clinical presentation, diagnostic studies, endovascular management, and outcome were analyzed for each patient.

Results Group I (n=19) 13 males, 6 females with an average age of 46.9 were diagnosed with traumatic aortic transaction. Only 3 had an open repair, 15 were treated with a stent graft, one ruptured before treatment. One patient had to be converted to open repair due to device maldeployment. Paraplegia occurred in only one patient. Group II (n=5) 4 males, 1 female average age 22.8 years had GSW to suprarenal aorta (n=2) or thoracic aorta (n=3), with distal emboli in 2. All endovascular patients underwent spiral CT scans and intravascular ultrasound (IVUS). Angiograms with multiple views were done in 18 (blunt=15, penetrating GSW=3) and identified aortic transection in 14, was equivocal in 1 but failed to identify aortic injury in 2 patients with GSW to the aorta. IVUS was able to identify the site of injury in all of them, and was used to properly select devices. Only one patient died from associated injuries, all aortic grafts are patent, secondary interventions were required in only one patient, with an average follow-up of 2.9 years.

Conclusions Traumatic injuries to the thoracic aorta can be rapidly and safely managed with stent grafts with a short-term outcome that compares favorably with open repair. IVUS interrogation is a sensitive and specific imaging modality in patients afflicted with these injuries and is successfully challenging the angiogram as the gold standard for the evaluation of suspected aortic injuries.

CHANGING TRENDS IN THE MANAGEMENT OF RENAL TRAUMA

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Introduction: As with other solid abdominal organ injuries, operative management of renal injuries continues to decrease. **Methods:** Retrospective review of patients sustaining renal trauma over a 5-year period at 4 Level I Trauma Centers. Patients were identified from trauma registries and departmental databases. Data collected included demographics, mechanism, associated injuries, injury grade, management and outcome. **Results:** 385 patients were identified (64% blunt, 36% penetrating; age 31 $\pm$ 15; 77% male, 23% female). Grade II injuries were most common 109/385 (28.3%), then Grade III (106/385; 27.5%); Grade I, IV, and V injuries accounted for 15%, 17%, and 12%, respectively. Two patients were omitted as the mechanism of injury was unclear. Of the 245 patients with blunt renal injuries, 203 (83%) were managed nonoperatively, 34 (14%) required operation, and 8 (3%) underwent angioembolization (AE). Of the 138 patients with penetrating injuries, 94 (68%) required operation, 41 (30%) were managed nonoperatively, and 3 (2%) underwent AE. The table depicts injury management over time.

Mechanism	Management	1999	2000	2001	2002	2003	2004	Overall
Blunt	Nonoperative	84%	66%	92%	100%	85%	68%	83%
	Operative	11%	17%	8%	0%	14%	27%	14%
	AE	0%	5%	0%	0%	2%	5%	3%
Penetrating	Nonoperative	0%	33%	50%	50%	28%	29%	30%
	Operative	100%	50%	50%	50%	70%	70%	68%
	AE	0%	17%	0%	0%	2%	0%	2%

A renal operative procedure was performed in 128 patients: 59 nephrectomies, 38 renorrhaphies, 7 partial nephrectomies, and 24 "other." Overall mortality was 12%; no death was attributable to the renal injury alone. **Conclusions:** 1. Blunt renal injuries are currently treated nonoperatively in over 80% of patients. 2. Reflecting the increasing use of CT to evaluate stable patients with penetrating flank wounds, nearly 1/3 of patients with penetrating renal injuries are now treated nonoperatively, as well. 3. Despite advances in AE, these techniques are rarely employed in the management of renal injuries.

CONTEMPORARY ANALYSIS OF THORACIC AORTIC INJURY: IMPORTANCE OF SCREENING BASED ON CRASH CHARACTERISTICS

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Objectives: To use motor vehicle crash (MVC) characteristics to determine risk of thoracic aortic injury (TAI) and provide updated mortality data. **Methods:** Vehicle crash and patient medical data from 64,245 MVC victims (1988-2002) were obtained from the National Automotive Sampling System (NASS). Descriptive and logistic regression analyses were used to determine the relationship of crash and occupant characteristics to TAI. **Results:** 790 victims (1.2%) had TAI. Overall mortality with TAI was 92%. Prehospital mortality was 63%. Of 216 patients taken to a trauma center (mean ISS 47) 75% died with mean ISS 51, and of 76 patients taken to a non-trauma center (mean ISS 49) 89% died with mean ISS 51 (p=0.006 for mortality). Crash characteristics and odds ratios (OR) for TAI are shown (risk factor in **bold**). No specific injuries or injury patterns reliably predicted TAI with sufficient sensitivity and specificity to be clinically useful.

Occupant & Vehicle variables	OR for TAI	P-value
Drivers: **Left side** (113) vs. frontal (267) impact	2.1	<0.0001
Front passengers: **Right side** (41) vs. frontal (92) impact	2.04	<0.0001
Rear (12) vs. frontal (384) impact	3.3	<0.0001
All seat positions: **Unbelted** (488) vs. belted (184)	5.32	<0.0001
Frontal, drivers: **unbelted** (200) vs. belted (54)	4.4	<0.0001
Left side, drivers: unbelted (57) vs. belted (48)	1.25	0.275
Frontal, drivers: **no airbag deploy**(200) vs. airbag deploy(65)	1.6	0.001
Left side, drivers: airbag deploy (26) vs. no deploy (87)	1.4	0.14
Delta V **>50mph** (173)vs. ≤ 50mph (219)	9.5	<0.0001
Passenger vehicle (637) vs. SUV or LTV (153)	1.7	<0.0001

Conclusions: TAI remains a highly lethal injury. Prehospital mortality in this series is lower than previously reported, and survival is higher at trauma centers vs. non-trauma centers. Risk of TAI is higher with near side (not frontal) impact, but seatbelts are protective only in frontal impact MVC. Associated injuries are poor predictors of TAI. Screening for TAI should include increased emphasis on crash and vehicle occupant characteristics, especially high velocity MVC, side impact, and lack of seatbelt use.

CHANGES IN ANTIBIOTIC SENSITIVITY FOLLOWING ONE YEAR OF ANTIBIOTIC ROTATION PROTOCOL IN AN INTENSIVE CARE UNIT

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Introduction: The use of an antibiotic rotation protocol within intensive care units has been proposed as a mechanism for limiting the development of antibiotic resistance. **Methods:** At the start of 2003, our surgical intensive care unit (SICU) instituted a protocol of monthly rotation of the antibiotics used in the empiric treatment of infections. Our medical intensive care unit (MICU) did not institute such a protocol. Using pre-selected organism-antibiotic combinations, we analyzed the change in antibiotic susceptibility profiles of clinically significant gram negative organisms isolated from patients in the SICU or MICU in 2002 and 2004 using chi-square testing or fisher's exact test where appropriate. **Results:** Institution of an antibiotic protocol in our SICU in 2003 resulted in an improvement in the antibiotic susceptibility profile for Pseudomonas aeruginosa isolates between 2002 and 2004. The susceptibility of Pseudomonas isolates to ceftazidime increased from 67% in 2002 to 92% in 2004 ($p=0.002$) and susceptibility to piperacillin also increased significantly from 78% to 92% over the same time period ($p=0.043$). In our MICU, the sensitivities of Pseudomonas isolates to these antibiotics decreased between 2002 and 2004, although these changes were not significant. Further, in our MICU, Pseudomonas isolates showed a trend towards decreased susceptibility to ciprofloxacin from 50% to 28% ($p=0.058$), while in our SICU Pseudomonas susceptibility to ciprofloxacin increased over the same time period from 71 to 75% (p=ns). Lastly, there was a significant decrease in Escherichia coli susceptibility to piperacillin (from 65 to 25%, $p=0.047$) in the MICU compared to an increase in the SICU (from 55 to 63%; p=ns). **Conclusion:** Institution of an antibiotic rotation protocol within our SICU resulted in a significant improvement in the antibiotic susceptibility profile of Pseudomonas aeruginosa isolates that was not observed over the same time period in our MICU, where no such protocol was employed.

INDICATIONS FOR ROUTINE REPEAT HEAD CT STRATIFIED BY SEVERITY OF TRAUMATIC BRAIN INJURY

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Background: Controversy exists as to the role of a routine repeat head CT in patients with TBI and an initially abnormal head CT. The specific aim of this study is to identify TBI patients who would benefit from a routine repeat head CT. Methods: Two year (2003 & 2004) prospective study of all blunt trauma patients admitted to an urban, level I trauma center that had an initial abnormal head CT. Results of initial head CT and indications for repeat head CT (routine vs. clinical change) were recorded. Interventions were both medical (diuresis, hyperventilation, barbiturates) and surgical (ICP monitor placement or craniotomy). Patients were categorized by Glasgow Coma Scale (GCS) as having mild (GCS 13 – 15), moderate (GCS 9 – 12), or severe (GCS $\leq$ 8) TBI. Results: There were 354 patients admitted with an initially abnormal head CT. The 37 (10%) patients who went directly to craniotomy and the 43 (12%) patients who died within 24 hours of admission were excluded from analysis. The remaining 274 patients (44 years old, 70% male, mean ISS = 19, mean GCS = 10) are the focus of this analysis. The indications for (clinical change vs. routine) and interventions after repeat head CT for each group shown below:

Head Injury	Clinical Change	Intervention	Routine	Intervention
Mild (n=142)	15 scans	5 (33%)	80 scans	0 (0%)
Moderate (n=42)	9 scans	3 (33%)	34 scans	0 (0%)
Severe (n=90)	21 scans	9 (43%)	82 scans	2 (2%)
Total (n=254)	**45 scans**	**17 (38%)**	**196 scans**	**2 (1%)**

The two patients who underwent an intervention after a routine scan had a GCS $\leq$ 8 at admission and at the time of routine repeat head CT. One patient had an ICP monitor placed and the other was taken for craniotomy. No patient with a mild or moderate TBI underwent an intervention following a routine repeat head CT. Conclusions: Patients with any TBI should undergo repeat head CT after neurological deterioration, as it leads to intervention in 38% of patients. Routine repeat head CT is indicated for patients with GCS $\leq$ 8, as results may lead to intervention without neurological change.

TRAUMA IN ADOLESCENTS CAUSES LONG-TERM MARKED DEFICITS IN QUALITY OF LIFE: ADOLESCENT CHILDREN DO NOT RECOVER PRE-INJURY QUALITY OF LIFE OR FUNCTION UP TO TWO YEARS POST-INJURY COMPARED TO NATIONAL NORMS.□

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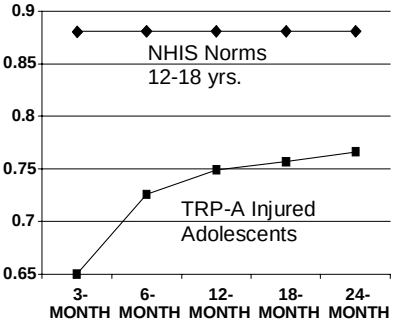
Introduction: Injury is a leading cause of death and preventable morbidity in adolescents. Little is known about long-term Quality of Life (QoL) outcomes in injured adolescents. The objectives of the present report are to describe long-term QoL outcomes and compare post-trauma QoL to national norms for QoL in *uninjured* adolescents from the National Health Interview Survey (NHIS).

Methods: 401 trauma patients aged 12 to 19 years were enrolled in the study. Enrollment criteria excluded spinal cord injury. QoL after trauma was measured using the Quality of Well-being (QWB) scale, a sensitive and well-validated functional index (range; 0 = death to 1.000 = optimum functioning). Patient outcomes were assessed at discharge, and 3, 6, 12, 18 and 24 months after discharge. NHIS data was based on 3 survey years and represents a population-based U.S. national random sample of uninjured adolescents.

Results: Major trauma in adolescents was associated with significant and marked deficits in QoL throughout the 24-month follow-up period, compared to NHIS norms for this age group, shown in the Figure below.



QoL deficits were also strongly associated with age (>= 15 years) and female gender. Other significant risk factors for poor QoL outcomes were pedestrian struck mechanism, perceived threat to life, and injury severity scores of greater than 16.

Conclusions: Major trauma in adolescents is associated with significant and marked deficits in long-term QoL outcomes, compared to U.S. norms for healthy adolescents. Early identification and treatment of risk factors for poor long-term QoL outcomes must become an integral component of trauma care in mature trauma care systems.

The Anatomic Injury Model (AIM-AIS): An AIS Based Outcome Prediction Model That Substantially Outperforms ISS

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The Injury Severity Score (ISS) has served as the primary measure of anatomic injury for over a quarter century, but the ISS fails to perform even as well far simpler models based upon the single worst injury (SWI) a patient has sustained. We believe that underlying "sum of squares" model for ISS is incorrect and as a result information present in AIS codes is lost when the ISS is computed.

We propose here the **A**natomic **I**njury **M**odel based upon **AIS** codes (AIM-AIS). AIM-AIS uses individual probabilities of survival for isolated AIS codes derived from the 448,100 patients in the NTDB data set using a logistic regression model averaging approach. These probabilities of survival are then transformed (log and 1/square root) and used in a logistic model that includes the worst two injuries in each of the nine AIS defined body regions. Crossvalidation (50%) of AIM-AIS demonstrates survival predictions dramatically better than either ISS or SWI by every measure considered.

Model	**ROC****	**HL Stat***	**R squared****	**AIC***
ISS	0.877	1702	0.278	0.295
Single Worst Injury	0.904	7099	0.288	0.291
AIM-AIS	0.920	120	0.436	0.232

(* =smaller value indicates better predictions, ** =larger value indicates better predictions)

Because the AIM-AIS is easily computed and substantially improves upon ISS and SWI we believe AIM-AIS should become the standard measure of anatomic injury. It is likely that more comprehensive outcome models that include physiologic reserve (e.g. age) and physiologic derangement (e.g. RTS) as predictors will better predict outcome if anatomic injury is incorporated as AIM-AIS rather than as ISS or SWI.

RECALIBRATION OF THE ABBREVIATED INJURY SCALE (AIS) SEVERITY SCORE USING THE NATIONAL TRAUMA DATA BANK (NTDB) IMPROVES MORTALITY PREDICTION

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Introduction: A recent analysis of NTDB data demonstrated that AIS severity scores have inconsistent mortality rates among various injuries with the same scores. As the original severity score assignments were created several decades ago using smaller data sets, such as the Major Trauma Outcomes Study (MTOS), we sought to recalibrate the AIS using the larger and more recent data set provided by the NTDB. We hypothesized that the calibrated AIS Severity Scale (CAIS) would be an improved predictor of outcomes.

Methods: The mortality rates for the AIS Codes of all isolated injuries in the NTDB were determined. Calibrated severity scores were developed using the following classification: 0% mortality = CAIS 0; 1-19% mortality = CAIS 1; 20-39% mortality = CAIS 2; 40-59% mortality = CAIS 3; 60-79% mortality = CAIS 4; 80-99% mortality = CAIS 5; 100% mortality = CAIS 6. **Results**: There were 1,190 AIS Codes represented by isolated injuries for which outcome data were available. With the new coding system, 178/249 (71.5%) of AIS =1 needed recalibration, as did 359/363 (98.9%) of AIS=2 codes, 289/297 (97.3%) of AIS = 3 codes, 131/137 (95.6%) of AIS =4 codes, 112/122 (91.8%) of AIS = 5 codes, and 20/22 (90.9%) of AIS = 6 codes. Predictive mortality was markedly improved from the original ISS scores (Figure 1) with the new CAIS system (Figure 2). **Conclusions**: Recalibration of AIS severity score based upon current mortality data from the NTDB improves the predictive capability of injury assessment. Further work to evaluate multiple injury incidents will complete the recalibration process.

Figure 1. Isolated injury ISS mortality rates extracted from the NTDB

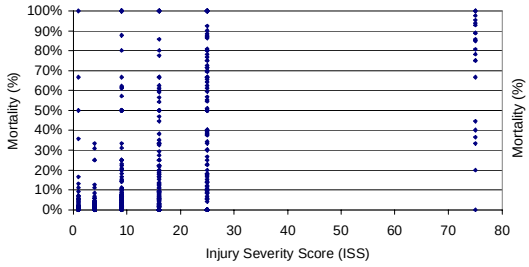
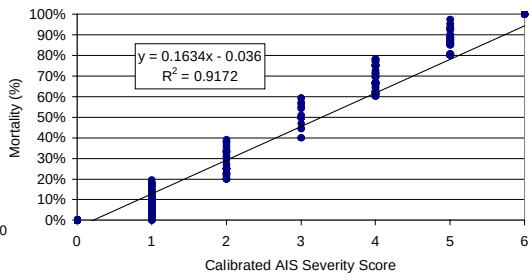


Figure 2. Isolated injury mortality rates using CAIS derived from NTDB data



TRAUMA IN SEPTUAGENARIANS AND OCTOGENARIANS: IS THERE REALLY A DIFFERENCE IN MORBIDITY, MORTALITY, AND OUTCOMES AT A REGIONAL LEVEL I TRAUMA CENTER?

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Introduction: As the United States population continues to age, death and disability related to trauma in the elderly will have a significant impact on our health care system. The purpose of our study was to examine outcomes in individuals ? 70 years of age related to morbidity, mortality, and disposition at a regional Level I Trauma Center.

Methods: A retrospective review of the Trauma Registry from August 2002 through January 2005 was conducted of all individuals age ? 70, and 507 patients were identified and studied. Patients were placed into two groups: Group 1 (70-79 years; n=277) and Group 2 (80 + years; n=230). Data collected included: age, demographics, Glasgow Coma Score, Injury Severity Score, Revised Trauma Score, mechanism of injury, hospital length of stay, mortality, and discharge disposition. All statistics were performed using the Fisher's Exact Test with p-values <0.05 considered statistically significant.

Results: There were no statistical differences in terms of Injury Severity Score, Glasgow Coma Score, or Revised Trauma Score (RTS) between the two study groups. Falls were the predominant mechanism of injury (Group 1 = 56.3% and Group 2 = 82.2%).

	Group 1 (70-79 Years)	*Group 2 (80+ years)*	*p-value*
Mortality Rates			
All patients	5.8%	17.4%	p<0.05
RTS=12	1.3	3.9	ns
RTS=11	11.1	68.4	p<0.05
RTS?10	52.6	66.7	ns
Disposition			
Home	66%	22%	p<0.05
Rehab	16	31	p<0.05
Nursing Home	12	29	p<0.05

Conclusions: Mortality rates due to trauma in octogenarians are three times that of septuagenarians. Septuagenarians are three times more likely to be discharged home following a trauma admission compared to octogenarians. Any physiologic derangement in an octogenarian as measured by an abnormal RTS is associated with mortality in two-thirds of patients.

Effects of adding omega-3 or omega-6 polyunsaturated fatty acids to parenteral nutrition on gut associated lymphoid tissue

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Background: Lack of enteral nutrition reduces gut associated lymphoid tissue (GALT) mass and function, a mechanism underlying increased morbidity of infectious complications in severely injured or critically ill patients. Because ω-3 and ω-6 polyunsaturated fatty acids (PUFAs) modulate host immune responses differently, adding these fats to TPN may have different effects on fat-free TPN-induced GALT atrophy.

Method: Male ICR mice (n=50) were randomized to 4 groups; *ad libitum* chow (Chow), fat free TPN (fat (-)-TPN), TPN + ω-3 PUFAs (ω3-TPN) and TPN + ω-6 PUFAs (ω6-TPN). The TPN groups were given isocaloric and isonitrogenous TPN solutions. The ω6- and ω3-TPN groups received 20% of total calories from fat emulsions. After 5 days of feeding, lymphocytes from Peyer's patches (PPs), the intraepithelial space (IE) and the lamina propria (LP) of the entire small intestine were isolated. GALT lymphocyte numbers and phenotypes (CD4, CD8, αβTCR, γδTCR, B cell) were determined. IgA levels of small intestinal washings were also measured by ELISA.

Results: Lymphocyte numbers from PPs and the LP and intestinal IgA levels were significantly lower in the TPN groups than in the chow group, with no significant differences between any two TPN groups. The ω3- and ω6-TPN groups showed moderate recovery of IE cell numbers as compared with the fat (-)-TPN group. There were no significant differences in any lymphocyte phenotypes among the four groups.

	n	GALT lymphocyte numbers ($\times 10^6$) PP	IE	LP	Small intestinal IgA levels (μg/ml
Chow	12	22.0±3.4	4.2±0.8	5.3±0.9	89.0±21.3
fat (-)-TPN	9	8.7±2.0	1.2±0.3	2.5±0.4	34.2±10.3
ω3-TPN	14	8.9±0.9	2.4±0.5	3.2±0.4	16.5± 24.1
ω6-TPN	15	11.7±1.1	3.6±0.8	3.7±0.7	27.4± 4.8

Means ± SEM * $P<0.05$ vs. Chow: ANOVA

Conclusions: Addition of ω-3 or ω-6 PUFAs to parenteral nutrition does not normalize TPN-induced GALT changes. Enteral nutrition is superior to fat-added TPN in terms of maintenance of gut mucosal immunity.

STRICT GLYCEMIC CONTROL IN CRITICALLY ILL TRAUMA PATIENTS: IS IT WORTH THE COST?

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Purpose: Recent literature has emphasized the role of strict glycemic control in critically ill patients as a method to decrease morbidity and mortality. This study assessed the role of strict glycemic control in critically ill trauma patients as well as the cost of implementing such a protocol.

Methods: All mechanically ventilated adult trauma patients admitted to the surgical intensive care unit at a level I trauma center from 9/01/03-6/30/05 were started on an intensive insulin therapy (IIT) protocol. The target normoglycemic range was 80-110 mg/dL. All patients meeting brain death criteria were excluded. Patient outcomes were compared to a matched control group of similarly injured trauma patients treated immediately prior to protocol initiation. Endpoints evaluated include; mortality, infections, ventilator days, renal failure, ICU and hospital length of stay. The protocol was evaluated in terms of the time required to achieve glycemic control and the initial 24 hour average glucose measurement in the treatment group. The estimated cost of the protocol was based on hospital billing data. A survey of nursing time was performed.

Results: Ninety-five patients comprised the treatment group and 85 the control group. No differences were observed between the control and treatment groups in terms of age, gender, injury severity score, and glascow coma scale. No differences were demonstrated in mortality, infections, ventilator days, acute renal failure, ICU length of stay, or hospital length of stay between the two groups. The time to the first glucose in range was 8.5 +/- 8.0 hours for the treatment group. The initial 24 hour average serum glucose was 125 +/- 26.0 for the IIT patients. The cost of the IIT protocol was in excess of $700 per patient day. Nurses spent 104 minutes per day implementing and maintaining the protocol.

Conclusion: Strict glycemic control may not improve morbidity and mortality in critically ill trauma patients. In addition, institution of an intensive insulin therapy protocol diverts nursing resources and increases the cost of patient care.

PROTEIN SUPPLEMENTATION AFTER INJURY: HOW MUCH IS ENOUGH?

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Introduction: We have previously demonstrated that nutritional replacement in the critically ill and injured can be accurately predicted with a weight-based formula (30 kcal/kg ideal body weight). However, given the catabolic nature of trauma and critical care patients, consensus regarding the ideal level of protein replacement in this population has not been reached.

Purpose: To evaluate the nutritional response of critically ill and injured patients to two different levels of protein replacement.

Methods: Prospective nutritional data was collected on trauma patients in the Surgical ICU admitted in 2005, in whom two or more weekly prealbumin levels were available for review. Patients were stratified as receiving normal (<2 gm/kg protein/day) or high ($\geq$ 2 gm/kg protein/day) levels of protein repletion.

Results: 49 patients (71% male, mean ISS 24 ± 14) formed the study group, 23 in the normal group and 26 in the high group. Days to goal nutrition (7 ± 4), age, gender, length of stay, route of nutritional repletion (enteral vs. TPN vs. both), ISS and incidence of complications were not different between the groups. Both groups had statistically significant improvements in serum prealbumin levels at the end of week 2. Administration of high protein resulted in early improvements in visceral protein, with the high group reaching a normal prealbumin level by week 3. Of infectious morbidities, only pneumonia tended to be lower in the high group (65% vs. 87%, p=0.08).

	Low group	High group	p value
Initial prealbumin	7.5 ± 2.6	8.7 ± 3.4	NS
Week 1 prealbumin	9.8 ± 4.1	12.5 ± 5.0	0.04
Week 2 prealbumin	12.4 ± 4.7	15.9 ± 7.4	NS
Week 3 prealbumin	13.2 ± 7.3	20.1 ± 10.6	NS

Conclusions: Administration of more than 2 gm/kg/day of protein may be beneficial in a population of critically ill trauma patients as normal visceral protein levels are more rapidly obtained, and infectious morbidity may be less.

ENTERAL SUPPLEMENTATION ENRICHED WITH GLUTAMINE, FIBER, AND OLIGOSACCHARIDE PREVENTS GUT TRANSLOCATION IN BACTERIAL OVERGROWTH MODEL.

Shiro Mishima, MD, assistant professor, Tetsuo Yukioka*, MD, PhD, professor

BACKGROUND: Normal gut flora plays an important role in the intestinal mucosal barrier function under various critical conditions. The flora may alter after severe insult, such as trauma and shock. Enteral nutrition should preserve the gut environment, however, fully support is usually difficult for severe ill patients because of impaired gastrointestinal motility. Currently, we have commercial enteral supplementation products GFO ® enriched with glutamine, dietary fiber, and oligosaccharide in Japan. This study examines the hypothesis that the enteral supplementation ameliorates gut injury induced by a bacterial overgrowth model (E. coli monoassociation), even in small volumes and quantities.

METHODS: Bulb/c mice received antibiotics (streptomycin 4 mg/ml) in their drinking water for 4 days to kill the normal gut flora following which they were orally inoculated with a streptomycin-resistant strain of *Escherichia. coli*, known as *E. coli* C-25. The animals were randomly divided into 2 groups and given 0.5 mL of GFO twice daily (GFO group) or 5 % of glucose solution as control. The mesenteric lymph nodes complex (MLNs) of the mice were harvested under general anesthesia and processed for bacterial translocation. The cecal population levels of bacteria, ileum histology, and myeloperoxidase assay were also examined.

RESULTS: The incidence and magnitude of bacterial translocation to the MLNs in the GFO group were lower than those in the control significantly ($p<0.01$). The cecal bacterial population level of the control group reached 9.7 1.1 (log10 CFU/g tissue), bacterial translocation would occur even in healthy animals. The GFO group had less bacterial population in the cecum significantly ($p<0.01$).

CONCLUSION: The glutamine, dietary fiber, and oligosaccharide enriched enteral supplementation reduced the bacterial translocation induced by the bacterial overgrowth model.

PERCUTANEOUS ENTERAL ACCESS IN TRAUMA PATIENTS: THE PLAYERS AND THEIR OUTCOMES

Nirav Y Patel MD*, Thomas H Cogbill MD*, Pamela J Lambert RN, Michelle A Mathiason MS

Introduction: Percutaneous enteral access (PEA) is increasingly being performed by interventional radiologists (IR). This study was undertaken to evaluate complications with respect to the performing specialty group: Surgeons - Percutaneous Endoscopic Gastrostomy (PEG), IR - Percutaneous gastrojejunostomy/gastrostomy (GJ/PG).

Method: Retrospective review from 1/1/00 to 12/31/05 of trauma patients undergoing placement of PEA. Variables reviewed included demographics, ISS, placement timing, complications and hospital charges. Complications were classified as major (hemorrhage, internal leak, peritonitis or fistula) or minor (dislodgement, external leak, superficial infection and malfunction). Data was analyzed using t-test and Fisher's exact test.

Results:

	Overall	PEG	GJ/PG	P
N	50	26	24	
ISS	33	35	31	0.372
Placement timing (days)	15	14	16	0.74
Complication (n)	7	0	7	0.01
Complication – Major (n)	1	0	1	
Complication –Minor (n)	6	0	6	
Hospital charge ($)		3700	1750	

83% of the minor complications required tube replacement in interventional radiology suite.

Conclusion: PEA is being performed by IR, at a lower charge, but with significantly higher complication rates. Although the majority of the complications were minor and resulted in no adverse outcomes, they required additional intervention in 83% of cases, potentially negating any charge advantage. Based on our data, we caution against the trend in PEA without further validation.

EARLY HYPERGLYCEMIA PREDICTS PERSISTANT HYPERGLYCEMIA IN SEVERLY INJURED TRAUMA PATIENTS

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OBJECTIVE: We hypothesized that early severe hyperglycemia would predict persistent hyperglycemia in severely injured trauma patients allowing identification of patients likely to benefit from early insulin therapy.

METHODS: Prospective, observational study of severely injured patients prior to implementation of an intensive glucose control protocol. Daily mean blood glucose (BG) measurements were determined for the first 10 days in the ICU. Early hyperglycemia was defined as daily mean BG ? 140 mg/dl within 48 hours of admission. Persistent hyperglycemia was defined as any daily mean BG ?140 mg/dl more than 48 hours after admission. Linear regression was used to determine if daily mean BG measurement in the first 48 hours predicted BG 10-day average. Multivariate logistic regression was used to assess the impact of early glucose measurements on persistent hyperglycemia.

RESULTS: Forty-two consecutive (ISS 22.9±12.6) patients were followed from admission until hospital discharge. Linear regression showed that the10-day average of daily mean BG was predicted by BG measurements within the first 48 hours but not by ISS or age (R-square = .62, $p < .001$). Persistent hyperglycemia was strongly associated with daily mean BG $\geq$ 140 mg/dl in the first two days (OR 8.2, p=.009) and was also associated with age (OR = 1.06 p=.04) but independent of ISS (p=.90).

CONCLUSION: Patients likely to benefit from early insulin therapy can be identified by hyperglycemia within the first 48 hours as manifest by BG ? 140 mg/dl. Patients without an early hyperglycemic response appear to maintain lower glucose levels during the first 10 days of hospitalization despite severity of injury.

MYELOID SUPPRESSOR CELLS MODULATE OUTCOME IN A TWO HIT SEPSIS MODEL

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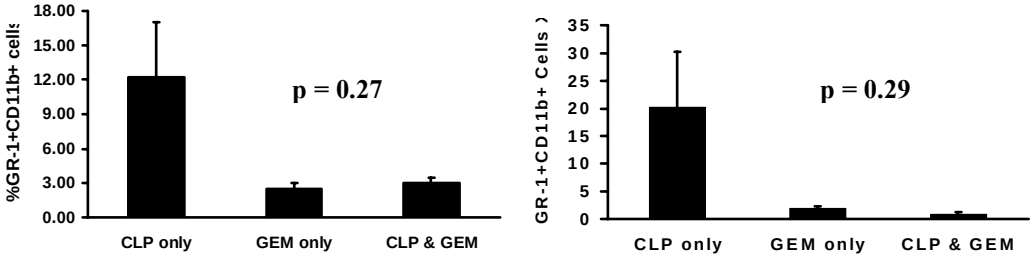
Objective: Increased susceptibility to infections is common following trauma, surgery, and sepsis. We recently found a ten-fold increase in GR-1^{+}CD11b^{+} myeloid precursor cells, termed myeloid suppressor cells (MSCs), 10 days after cecal ligation and puncture (CLP). In order to determine the impact of MSCs on survival following a secondary infection with intranasal *Pseudomonas aeruginosa*, we depleted MSCs using gemcitabine, a nucleoside analogue that specifically inhibits MSC accumulation without affecting terminally differentiated cells. ***Methods:*** Female, 6-8 wk old C57BL6j mice underwent CLP (LD10) and at day 5 received either gemcitabine (120 mg/kg body weight) or normal saline control. At day 7 after CLP (n = 5), total splenocytes were stained for MSCs, and other leukocyte populations, and analyzed by flow cytometry. ***Results:*** The percentage and total number of GR-1^{+}CD11b^{+} splenocytes were significantly decreased between the CLP plus gemcitabine group and the CLP only group (p=0.027, p=0.029). The percentages of CD4^{+} and CD8^{+} T lymphocytes, dendritic, B, and NK cells did not achieve statistical significance between the two groups (p > 0.05). Furthermore we found that gemcitabine increased the mortality to Pseudomonas challenge seven days after CLP (p=0.02).

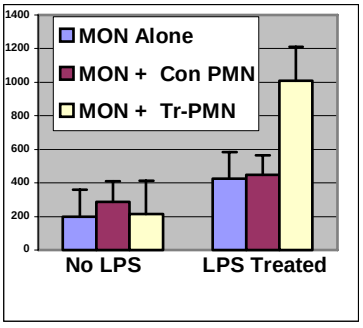


Conclusion: We have demonstrated that gemcitabine specifically prevents the accumulation of MSCs in the spleen after CLP and increases the mortality to a secondary bacterial challenge. These data demonstrate that the induction of MSCs may be beneficial to host survival following sepsis.

POST-INJURY NEUTROPHILS AUGMENT THE MONOCYTE CYTOKINE RESPONSE TO INFECTION

Asit De, PhD, Edward Piotrowski, MD, Peter Crane, MD, Mita De, MS, and Paul Bankey, MD, PhD*

Injury results in impairment of host defenses resulting in an increased risk of infection. Depressed cellular immunity including impaired antigen presentation and T cell responses has been reported. Recently an expanded role for neutrophils in cellular immunity has been proposed. Anti-apoptotic neutrophils have been demonstrated to produce immuno-stimulatory cytokines, recruit monocytes and T cells to sites of injury, and assist in monocyte and T cell differentiation. We hypothesized that post-injury neutrophils modify monocyte immune responses. To test this we determined the production of monocyte chemoattractant protein-1 (MCP-1) and expression of CD 11b in co-cultures of neutrophils from injured versus non-injured subjects with monocytes. Cultures of monocytes alone served as a control. Neutrophils were isolated by centrifugation and Ficoll gradient from 8 blunt trauma patients, ISS > 16, ICU admission, within the first 5 days of injury (97% PMNs). PMNs were cultured with the monocytes cell line THP-1 cells (1:1 PMN:THP-1 ratio) with or without 100 ng/ml LPS for 16 hours. THP-1 cells were used for cell purity of the monocyte population. Culture supernatants were assayed for MCP-1 using commercial elisa. Recovered THP-1 cells were analyzed by flow cytometry for surface expression of CD 11b. THP-1 cells cultured with PMN from trauma patients produced significantly more MCP-1 after LPS stimulation compared to THP-1 cells alone or THP-1 cells co-cultured with PMNs from uninjured subjects.(figure, $p > 0.05$ ANOVA,Tukey's test). CD 11b was not significantly changed by co-culture with either PMN group. We conclude that post-injury neutrophil-monocyte interactions augment the production of immuno-regulatory cytokines. These results suggest that post-injury neutrophils may augment host defense by upregulating recruitment of monocytes and their cytokine production.



DOES HIV INFECTION INFLUENCE OUTCOMES AFTER TRAUMA?

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Purpose: Present literature is unclear as to the influence of Human Immunodeficiency Virus (HIV) infection in trauma. Our goal was to determine if the presence of HIV infection effects outcome after trauma. **Methods**: We performed a retrospective review of trauma patients from 2000 to 2005 comparing HIV positive patients to a non-infected matched cohort. **Results**: A group of 54 HIV + patients were compared to 200 HIV – patients who were equally matched for demographics, mechanism, and injury severity. The groups had similar co-morbidities except for more coagulopathy (0% vs. 3.7%, p=-.04) and more renal failure (0.5% vs. 9.3%, p=0.002)) in the HIV + group. There were more overall complications in the HIV+ group but not specifically infectious complications.

	HIV -	HIV +	P value
Overall Complications	9.0%	22.2%	0.02
Respiratory	0.5%	5.6%	0.03
Renal	0%	5.6%	0.009

No differences were found between the groups regarding ventilator, ICU or hospital lengths of stay. They also had similar mortality rates. In the HIV + group 34 had known CD 4 counts which averaged 474.6 ± 457.4 cells/μL. There were 7 who had a CD 4 count less than 200 cells/ μ/L of whom 5 had complications, and 3 had infectious complications. These were not statistically different from those who had CD 4 counts ? 200 cells/μL. Regression analysis did not demonstrate any difference in overall complications (p=0.37) or infections (p=0.38) regardless of the CD 4 count.

Conclusions: Although HIV infected patients suffer more complications than their non-infected counterparts, HIV does not alter the outcomes for trauma patient. HIV status should not influence management decisions for these patients regardless of the patient's CD 4 count.

IS IT FEASIBLE AND SAFE TO PERFORM A DEFERRED PRIMARY ANASTOMOSIS IN CRITICALLY ILL PATIENTS WITH SEVERE SECONDARY PERITONITIS?

Ordóñez. C MD Fundación Clínica Valle del Lili. , Pineda J. MD Fundación Clínica Valle del Lili. , Arias R.MD Fundación Clínica Valle del Lili. , Martínez .J MD Fundación Clínica Valle del Lili. , Rosso F. MD Fundación Clínica Valle del Lili. , Granados M. MD Fundación Clínica Valle del Lili. , Toro L. MD Fundación Clínica Valle del Lili. , Benítez F. MD Fundación Clínica Valle del Lili. , Fajardo M. MD Fundación Clínica Valle del Lili. , Aristizábal G. MD Fundación Clínica Valle del Lili. , Puyana JC* MD University of Pittsburgh

The management of critically ill patients (pts) with severe complicated peritonitis often requires multiple operations and aggressive washout and debridment. Restoring bowel continuity is a major determinant of outcome. However, optimal timing of anastomosis and how to minimize the need for stomas remained unanswered. The objective of this study was to evaluate the use of deferred primary anastomosis (DPA) as a viable option in an established protocol of staged laparotomies and damage control (DC) in critically ill pts with severe intra-abdominal sepsis (IAS). **Methods**: Pts with IAS that underwent bowel resection and disruption of bowel continuity as part of DC were entered in the study. DPA was done as soon as pre-established criteria regarding control of septic foci, drainage and septic shock were achieved. Laparotomies were done every 24 hours with an open abdomen technique using Velcro. Successful outcome was defined as restoration of bowel continuity without anastomotic leak or fistula. **Results**: Twenty six pts compromised the study. DPA was performed in 23/26 pts; anastomosis could not be performed in 3pts; 3/23 developed fistulae. The pts with fistula ultimately underwent successful restoration of GI continuity. Average age was 54.5 ± 22.8 years (18-91). The source of IAS was peritonitis from a previous (before entering the study) anastomotic leak in 3 pts, 11 with primary bowel perforation, 6 with IAS due to penetrating bowel trauma and 6 with ischemic bowel necrosis. APACHE II was 15.3 ± 6.5. The anastomosis was done in 19 pts at the 3rd or 4th operation, 2 at the second operation and in 6 after the 5th laparotomy. The overall mortality was 3/26; no mortality in the pts that underwent DPA. **Conclusion:** Primary success was achieved in 77% of the cases, the incidence of fistula was 11.5 % and the overall mortality was low (11.5%). DPA strategy as part of a scheduled daily laparotomy for DC in critically ill patients with severe secondary peritonitis and sepsis is a feasible and safe option.

THE SERIAL EVALUATION OF LIPOPOLYSACCHARIDE-BINDING PROTEIN (LBP) IN CRITICALLY ILL TRAUMA PATIENTS

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Background The purpose of this study was to observe the time-dependent changes in Lipopolysaccharide-binding protein (LBP) levels among critically injured trauma patients.

Methods Prospective, single-institution cohort study of adult trauma patients (Age >17 years) admitted to the intensive care unit (ICU) over a 6 month period. Daily serum samples were collected over the first 6 hospital days. Plasma concentrations of LBP were measured by enzyme-linked immunosorbent assay (ELISA).

Results A total of 37 patients were evaluated. The mean age was 49.4 ± 6.5 years and 86% were male. 89% of the injuries were blunt and 11 % penetrating. 21(54%) of the 37 patients developed an infection in the first week after injury. The mean ICU and hospital length of stay were 16.2 ± 6.2 and 21.3 ± 6.7 days with a 13.5% mortality rate. There were statistically significant increases in LBP levels from day 1 to day 2 (p=0.004) and day 2 to day 3 (p=0.003), but these increases were not associated with increased infection or mortality. However, increased LBP was predictive of mortality on Day #6 (p<0.05) even when adjusted for age (p<0.05). Thus, the odds of death increased 1.04 fold for every 1 mg/L increase in LBP.

	LBP level (mg/L)	Odds Ratio Mortality	Confidence Interval
Day 1	33 ± 29	1.00	(0.97-1.03)
Day 2	54 ± 34*	1.01	(0.98-1.04)
Day 3	79 ± 36*	1.01	(0.98-1.03)
Day 4	79 ± 38	1.00	(0.98-1.03)
Day 5	77 ± 38	1.00	(0.98-1.03)
Day 6	85 ± 37	1.04*	(1.00-1.09)

Data reported as Mean ± Standard Deviation, * denotes p=value <0.05

Conclusion: LBP is a non-specific marker which increases significantly immediately post-injury in critically injured trauma patients. Although it is associated with increased mortality post the early resuscitative phase, future investigation will be necessary to define the physiologic mechanism associated with this risk.

COSTS OF CARE IN SEVERE TRAUMATIC BRAIN INJURY AND THE INCREMENTAL IMPACT OF INFECTIONS

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Traumatic brain injury (TBI) patients have long ICU and hospital length of stay (LOS) and high rates of infection. Little data exist on costs of care for this population. The purpose of this study is to determine the costs of care for patients with severe TBI and the incremental impact of infections. **Methods:** Data from a recent study of 59 severe TBI patients were analyzed. Inclusion criteria were: severe TBI with GCS<9, age>16, ICU LOS>24 hrs, on ventilator. Cost data were obtained from hospital accounting. Data were analyzed using descriptive statistics and ANOVA. **Results:** Mean age was 36 years; 75% were male. 137 infections occurred, most commonly pneumonia (64%). Increasing number of infections was associated with increased ventilator days, ICU LOS, and hospital LOS ($p<0.05$;Table 2). Mean total costs of hospitalization were $53,456. There was a significant increase in costs as the number of infections increased ($p<0.05$). Each additional infection increased total costs by an average of $16,000 and was related to increased LOS. Pharmacy costs increased by an average of $1,400 with each additional infection. **Conclusions**: Costs of care in severe TBI are high and increase incrementally with increasing numbers of nosocomial infection. Pharmacy costs contribute relatively little to these increases. These data suggest that substantial investments in infection control along with aggressive implementation of proven therapeutic strategies should decrease the costs of care in this population.

Table 1	
Mean field GCS	6
Mean ISS	32
Hospital LOS	24
ICU LOS	12
Ventilator days	14
% with infection	80
Ave infections/pt	2
Mortality %	24

Table 2 Infections (Number)	Ave Vent Days	Ave ICU LOS	Ave Hosp LOS	**Mean Total Costs**	Mean Pharmacy Costs
0-1(n=12)	8.6	8.3	12.4	**$32,742**	$3,134
2 (n=23)	12.5	11.1	20.7	**$46,653**	$4,314
3 (n=12)	15.8	12.6	29.3	**$62,421**	$6,158
4+ (n=11)	18.9	14.8	37.5	**$80,497**	$7,351

CYTOKINE PRODUCTION IN LPS EXPOSED RAT LUNG PERICYTES

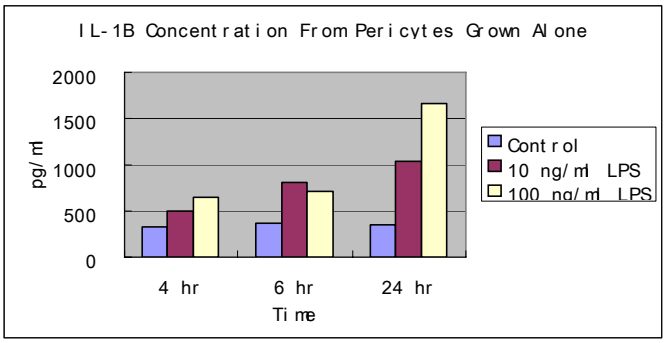
David Edelman, MD Wayne State University, James Tyburski*, MD Wayne State University, Robert Wilson*, MD Wayne State University, Chris Steffes, MD Wayne State University

Objective: Evaluate secretory cytokine production by rat microvascular lung pericytes (RLP) in response to LPS.

Methods: RLPs were isolated and grown either alone or in co-culture with rat endothelial cells. Cells from passage 3-5 were used and treated with LPS (control, 10 ng/ml, and 100 ng/ml) for varying amounts of time. Immunoblotting and RT-PCR was used for detection and quantification of NF-kB. ELISA and RT-PCR was used for detection and quantification of cytokines.

Results: The protein and mRNA for NF-kB was detected in RLPs. Additionally, NF-kB mRNA increased with exposure to LPS. The supernatant of RLPs exposed to LPS contained IL-1B, and IL-1B increased in a time and dose dependant manner. An increase in mRNA for IL-1B, IL-6, and TNF-A was seen in a dose dependant fashion. Co-cultures produced significantly less IL-1B when exposed to similar concentrations of LPS. RT-PCR demonstrated the message for TLR-4 and CD-14 (LPS receptors) was not up-regulated in pericytes from the co-culture LPS activated model.

Conclusions: Pericytes contain the machinery necessary, and produce pro-inflammatory cytokines. Co-cultures manufacture less IL-1B then pericytes alone, which is similar to previous co-culture observations. Pericyte activation and cytokine production may play a role in capillar



SIRS-ASSOCIATED COAGULOPATHY: WHICH ORGAN IS THE TARGET?

Hiroshi Ogura, M.D.* for the Japanese Association for Acute Medicine (JAAM) DIC Study Group, Japan

Backgrounds: Coagulopathy and thrombocytopenia often occur in severe SIRS patients. We recently reported that SIRS-associated coagulopahty (SAC) can induce disseminated intravascular coagulation (DIC) and multiple organ dysfunction syndrome (MODS). In this study, we evaluated the impact of thrombocytopenia on vital organ functions, and examined which organ is the major target in SAC. **Patients and Methods:** Two hundred and thirty-five patients, who were admitted to 13 critical care centers in Japan and fulfilled the criteria of SIRS and of platelet counts < 150 x10^3/μL, were included. Coagulative variables (platelet counts, FDP, and Japanese DIC score), SIRS score, and organ dysfunction index (SOFA score in each organ) were evaluated in the consecutive 4 days after fulfilling the above entry criteria. Platelet counts were divided into four categories: 0 ~ 40, 40 ~ 80, 80 ~ 120, and 120 ~ (x10^3/μL). **Results:** The minimum platelet counts had significant negative impacts on the maximum SIRS score, SOFA score, coagulative disorders indicated by the maximum FDP levels, DIC score, and DIC diagnostic rate (score > or =7) during the study period, and on mortality at 28 days. The SOFA score in each vital organ gradually worsened depending on the decrease of platelet counts.

Platelets (10^3/μL)	**0 ~ 40** (n=57)	**40 ~ 80** (n=66)	**80 ~ 120** (n=68)	**120 ~** (n=44)
SOFA score	**10.5 ± 3.7 * # !**	**8.9 ± 3.5 # !**	**6.2 ± 3.1**	**5.2 ± 2.8**
Heart	**2.4 ± 1.4 * # !**	**1.9 ± 1.3 # !**	**1.3 ± 1.3 !**	**0.5 ± 0.9**
Lung	**2.8 ± 1.1 # !**	**2.5 ± 1.1 !**	**2.0 ± 1.5**	**1.8 ± 1.3**
Liver	**1.6 ± 1.0 # !**	**1.4 ± 1.0 # !**	**1.0 ± 1.1 !**	**0.6 ± 0.8**
Kidney	**2.0 ± 1.6 * # !**	**1.3 ± 1.4 # !**	**0.5 ± 1.0**	**0.4 ± 1.1**
DIC (+) (%)	**89.5 * # !**	**50.0 # !**	**20.6 !**	**6.8**
Mortality (%)	**36.8 * # !**	**19.7 # !**	**7.4**	**4.5**

*p < 0.05 vs 40 ~ 80, # p < 0.05 vs 80 ~ 120, **!** p < 0.05 vs 120 ~ . Data as Mean±SD.

Conclusions: In SIRS patients, MODS progress depending on the degree of thrombocytopenia and coagulopathy. Lung may be the early target in SAC, and systemic vital organs may be the simultaneous targets when SAC advances.

EVOLVING PATHOGENS IN A SURGICAL INTENSIVE CARE UNIT

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Background: Changing pathogenic organisms responsible for infections in the surgical intensive care unit (SICU) will influence empiric antibiotic selection for suspected infections. The purpose of this study was to identify the change (if any) of bacterial organisms causing infections in a SICU.

Methods: Retrospective study of SICU admissions to an urban tertiary referral center from 2000-2005. Positive culture results (blood, respiratory, urine) were recorded from the SICU epidemiological database. Culture results were classified as Gram Positive (GP) or Gram Negative (GN), and further stratified by specific organism. Culture results from 2000-2002 (Past group) were compared with culture results from 2003-2005 (Present group).

Results: There were 1,164 SICU patients (43 years old, 76% male, 64% trauma, APACHE: 22) who developed 2,260 positive cultures (849 blood, 2,022 respiratory, 381 urine). While there was no difference in positive blood cultures caused by GP or GN organisms between groups, GP's became more common in the present group for both respiratory and urine cultures.

	%GP 2000-2002	%GP 2003-2005	p-value
Blood	54%	60%	0.32
Respiratory	33%	42%	<0.0001
Urine	28%	48%	0.004

For both blood and respiratory cultures, Oxacillin Resistant *Staphylococcus aureus* (ORSA) was a more common GP pathogen in the present group (blood: 22% vs. 7%, p = 0.004, respiratory: 20% vs. 11%, p = 0.004). Likewise, ORSA represented a larger proportion of *Staphylococcal* species (blood: 50% vs. 21%, p = 0.01, respiratory: 30% vs. 21%, p = 0.04) in the present group.

Conclusions: GP organisms play an increasing pathogenic role for infections in SICU patients. In addition, *Staphylococcal* species have become more common with a significant increase in the proportion of resistant strains (ORSA).

THE ROLE OF FEVER IN TRAUMA PATIENTS: A FRIEND OR A FOE?

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Purpose: In trauma patients, elevated body temperature is a common and non-infective procedure early after injury. We hypothesized that non-febrile is associated with failure of metabolic demand and result in adverse outcomes following traumatic injury. **Methods:** Retrospective data was collected on 253 consecutive trauma patients admitted to the ICU over-3 year period. Patients who were, received normothermia or hypothermia therapy, ISS<5, transferred from other hospital and dead within 24 hr after admission were excluded from the study. Patients were stratified by maximum Temperature from day 1to day 10 (Tmax1-10, none = <37.5 ℃, low = 37.5-38.4 ℃, moderate = 38.5-39.0 ℃, high = > 39.0 ℃). Furthermore, the area under the curve of core temperature of first 24 hours at baseline 36 ℃ (AUC) was calculated for each patient. Outcome was measured by infection and mortality. **Results:** Sixty three patients (24.9 %) developed an infection and overall mortality was 7.5 %(19 patients). Patients with none of Tmax 1-2, high of Tmax 6-10, moderate of Tmax 5-10, and low of Tmax 6-10 were found to have significant increased infection rate and mortality. Low AUC was also associated with significantly higher infection and mortality rates. Multiple logistic regression to control for age, ISS, Tmax 1, AUC, initial Temperature, time until 36 ℃ (if hypothermia was presented) found age, ISS, low AUC, initial Temperature to be an independent predictor of infection and mortality.

Variable	*p* Value (Infection)	OR (95%CI) (Infection)	*p* Value (Mortality)	OR (95%CI) (Mortality)
Age	.028	1.02 (1.00-1.03)	.006	1.07 (1.02-1.12)
ISS	.001	1.05 (1.02-1.08)	NS	
AUC	.002	0.96 (0.94-0.99)	<.001	0.87 (0.81-0.92)
T max 1	NS		NS	
Initial Temperature	.035	0.70 (0.05-0.98)	NS	
Time until 36 ℃	NS		NS	

Conclusion: Febrile response until day 5 did not increase morbidity and low AUC is independently associated with adverse outcome. These finding shows that non-febrile response result in poor prognosis early after injury.

PERSISTENT HYPERGLYCEMIA IN SEVERE TRAUMATIC BRAIN INJURY: AN INDEPENDENT PREDICTOR OF OUTCOME

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Introduction: Admission and persistent hyperglycemia has been shown to affect outcome in critically ill patients. In patients with severe traumatic brain injury (TBI), admission hyperglycemia is associated with poor outcome. The effect of persistent hyperglycemia on TBI remains unknown. **Methods:** Retrospective review of all blunt trauma patients with severe TBI (Head abbreviated injury score ? 3) admitted to the intensive care unit (ICU) at a level – I trauma center from January 1998 to December 2003. Admission and daily ICU blood glucose (BG) levels up to the end of the first week were measured. Hyperglycemia was defined as an average daily BG ? 150 mg/dl. TBI patients with and without hyperglycemia were compared with respect to baseline demographics and outcomes. Independent risk factors for mortality were identified using logistic regression analysis. **Results:** During the study period, 555 severe TBI patients were admitted to the ICU. The table below compares the characteristics and outcomes with and without hyperglycemia. After adjusting for age, blood pressure, and Injury Severity Score (ISS), hyperglycemia was identified as an independent risk factor for mortality (OR 3.9 [95% CI, 2.6-5.9, p<0.01]). **Conclusions:** Persistent hyperglycemia is associated with significantly higher mortality rates in severe TBI patients. Evaluation of aggressive glycemic control in patients with TBI is warranted.

	BG <150 (N=285)	**BG ? 150 (N=270)**	**P-Value**
Age (y)	35	45	<0.01
% Male	72	73	0.73
ISS	25	31	<0.01
ICU-LOS (days)	7.4	10.5	<0.01
Hosp-LOS (days)	14.7	18.2	0.02
Complications (%)	29	46	<0.01
Mortality (%)	18	50	<0.01

PREDICTORS OF POST-CONCUSSIVE SYMPTOMS AT THREE MONTHS

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Objective: to determine predictors of outcome among patients with mild traumatic brain injury (TBI). **Methods:** subjects with either a GCS 13-15, transient loss of consciousness or confusion, and normal brain CTs were recruited at a level I trauma center. S-100 B levels and the concussion symptom checklist were obtained on admission. Symptoms were reassessed at 3-5 days and at 3 months. Symptoms were classified as physical (headaches, dizziness, double vision, fatigue, photophobia and noise sensitivity), cognitive (concentration, memory and thinking difficulties) and emotional (anxiety, depression and irritability). The outcome studied was the number of symptoms at 3 months. Linear regression models (α=0.05) including S-100B, age, gender, education, ISS, previous TBI, and baseline and initial symptoms were built. **Results:** Data were available for 108 patients with 59 completing 3-month evaluations. Subjects were on average 34 years old, 54% male and 37% had $\leq$ 12 years of education. Following injury, the percentage of cases reporting $\geq$ 4 symptoms increased from 26% pre-injury to 73% at 3-5 days, declining to 39% by the third month. Physical symptoms were present in 95% of the patients at 3-5 days. At the three month follow-up the proportion of subjects with physical symptoms had returned to pre-injury levels. Emotional and cognitive symptoms remained elevated (35% and 37% at baseline, 53% and 66% at 3-5 days, and 51% and 61% at 3 months respectively). Predictors of increased symptomatology at 3 months included older age, female gender, higher educational achievement, and previous TBI. Pre injury and initial symptoms, ISS, and elevated S-100 B did not predict 3 months increased symptomatology. **Conclusion:** Initial symptoms and elevated S-100 B levels do not predict post-concussive symptoms at 3 months. Older age, female gender, higher educational achievement and history of previous TBI, however, were found to be significant predictors of outcome among mild TBI patients. While physical symptoms are more commonly reported initially, cognitive and emotional symptoms are more likely to persist for 3 months.

SEVERE CLOSED HEAD INJURY IN PATIENTS ON ORAL ANTICOAGULATION WHO FALL FROM STANDING

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Introduction: A fall from standing (FFS) is a common mechanism of injury in trauma patients on oral anticoagulation (OAC). This study was performed to examine this patient population and test the hypothesis that admission Glasgow Coma Score (GCS) correlates with outcome and severity of closed head injury (CHI) in these patients. **Methods:** A retrospective review of prospectively collected registry and medical record data was performed. Data collected for 2003 through 2005 included patient demographics, CT head (CTH) results, injury severity score (ISS), abbreviated injury score (AIS) for head, mortality, admission INR, and need for craniotomy. **Results:** Over this period, 12,418 patients were admitted to the trauma service. There were 230 FFS/OAC patients. There were 21 deaths (9.1% mortality) in this group. 129 had a negative CTH with 5 deaths, none due to head injury. 29 patients had no CTH with 2 deaths, both caused by severe CHI determined by autopsy. 72 CTH scans were positive for head injury, 5 were initially negative. There were 14 deaths in this group. The tables summarize data in patients with severe CHI, i.e., those with AIS head 4 and 5.

	N	Deaths (% Mortality)	Craniotomy
GCS 14-15	37	6 (16.2)	11 (3 deaths)
GCS 9-13	7	1 (14.3)	4 (0 deaths)
GCS ?8	10	7 (70)	1 (0 deaths)

	Age	GCS	ISS	INR
Survivor (N=40)	75.1 ± 11.14	13.6 ± 2.63	19.4 ± 4.46	2.8 ± 2.15
Nonsurvivor (N=14)	79.9 ± 7.21	9.4 ± 5.23	25.5 ± 0.65	2.9 ± 0.96
P value	p=0.04	p=0.01	p=0.003	NS

Value=mean ± SD; P values determined using unpaired t-test.

Conclusion: There is substantial mortality in FFS/OAC patients caused predominantly by severe CHI. Admission GCS does appear to correlate with mortality; however, it does not appear to predict severity of CHI as judged by AIS scoring and need for craniotomy. While most of these patients are awake on presentation, the data suggest that FFS/OAC patients should not be triaged according to their GCS.

OUTCOMES IN SEVERE BRAIN INJURY ARE ASSOCIATED WITH NONINVASIVE BISPECTRAL INDEX AND CEREBRAL OXIMETRY VALUES

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Objective: To determine if noninvasive transcranial oxygen saturation ($StcO_2$) and bispectral index (BIS) values correlate with severe brain injury outcomes.

Methods: Fourteen consecutive adult brain-injured patients with admission GCS 3-8 and intracranial hemorrhage were studied. $StcO_2$ and BIS values were documented hourly for the first six, post-injury days.

Results: There were 2 hospital deaths. Four patients had a poor outcome (2 patients with hospital discharge GCS 3-8 and 2 deaths).

	Hours	ICP	CPP	ICP/CPP	$StcO_2$	BIS
Deaths	210	30.4	65.2	0.71	60.8	47.8
Survivors	1,580	11.7	81.4	0.15	70.0	52.2
P-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Poor Outcome	472	19.6	71.2	0.40	61.1	44.5
Good Outcome	1,318	11.8	82.6	0.15	71.4	54.2
P-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

ICP/CPP and $StcO_2$ had an inverse relationship ($p < 0.0001$). ICP/CPP and BIS had an inverse relationship ($p < 0.0001$). $StcO_2$ and BIS had a direct relationship ($p < 0.0001$). BIS, $StcO_2$, and CPP were independently associated with poor outcome ($p < 0.0001$; $r^2 = 0.34$). ICP < 20 mmHg rate was 90% with BIS $\geq$ 60 and $StcO_2 \geq 60$ (OR 3.6; $p < 0.0001$). ICP < 20 mmHg rate was also 90% with BIS $\geq$ 50 and $StcO_2 \geq 70$ (OR 2.2; $p < 0.0001$).

Conclusion: Decreased cerebral oxygen saturation and decreased BIS values are associated with death and poor outcome in severe brain injured patients. These lower values are also seen when there is increased ICP relative to CPP. These observations suggest that cerebral ischemia can cause hypoxia and alter brain wave patterns. Future severe brain injury studies with noninvasive BIS and cerebral oxygen monitoring may demonstrate prognostic and therapeutic value and may show that ICP monitoring is not needed in select patients.

INTRACRANIAL PRESSURE MONITORING IN BRAIN-INJURED PATIENTS IS ASSOCIATED WITH WORSENING OF SURVIVAL

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Objectives: According to Brain Trauma Foundation (BTF) criteria, intracranial pressure (ICP) monitoring is recommended in traumatic brain injury (TBI) patients with Glasgow Coma Scale (GCS) of 8 or less, and an abnormal brain CT. However, benefits of ICP monitoring have not been adequately documented. ICP readings may prompt therapies with adverse extra-cranial effects (intubation, pressors, diuretics, hyperventilation, chemical paralysis, sedation) that adversely affect survival. We hypothesized that ICP monitoring is associated with improved survival in TBI patients.

Methods: The National Trauma Data Bank (1994 – 2001) was analyzed. Inclusion criteria were blunt TBI with Head AIS 3-6, age 20-50 years, GCS $\leq$ 8, abnormal brain CT scan, and ICU admission for 3 days or more. Early deaths (< 48 hours) and delayed admissions (> 24 hrs after injury) were excluded. Patients who met BTF criteria and underwent ICP monitoring (n=708) were compared with those did not (n=938). Multivariate logistic regression was used to determine the relationship between ICP monitoring and survival, while controlling for overall injury severity (ISS, RTS), TBI severity (AIS, GCS), craniotomy, associated injuries, co-morbidities, and complications.

Results: ICP monitoring was performed in only 43% of patients who met BTF criteria. There were no group differences in age, gender, or GCS. After adjusting for multiple potential confounding factors including, admission GCS, age, blood pressure, head AIS, and ISS, ICP monitoring was associated with a 45% reduction in survival (table).

	OR	95% C.I.	p-value
All patients	0.55	0.39 – 0.76	.000
Head AIS 3	0.57	0.21 – 1.51	NS
Head AIS 4	0.37	0.16 – 0.69	.003
Head AIS 5	0.61	0.39 – 0.93	.023

Conclusions: ICP monitoring is associated with worse survival in TBI patients. BTF criteria for monitoring do not appear to select patients who benefit from it. Studies to determine if this is due to selection bias or because monitoring prompts more aggressive use of harmful therapies are warranted.

BLAST INJURY IN A CIVILIAN TRAUMA SETTING IS ASSOCIATED WITH A DELAY IN DIAGNOSIS OF TRAUMATIC BRAIN INJURY

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Background: High pressure waves (blast) account for the majority of combat injuries and are becoming increasingly common in terrorist attacks. To our knowledge, there is no data evaluating the epidemiology of blast injury in a domestic non-terrorist setting. **Methods**: Data was analyzed over a 10 year period at a busy urban trauma center. Injuries were classified by etiology of explosion and anatomical location. **Results**: 89 cases of blast injury occurred in 57,392 patients (0,2%) treated over the study period. The majority of patients were male (78%) with a mean age of 40 ± 17 years. The mean ISS was 13 ± 11 with an admission TRISS of 0.9 ± 0.2 and RTS of 7.5 ± 0.8. The mean ICU and hospital length of stay was 2 ± 7 days and 4.6 ± 10 days respectively with an overall mortality rate of 4.5%. Private dwelling explosion (n = 31 or 35%) was the most common etiology followed by industrial pressure blast (n =20 or 22%), industrial gas explosion (n = 16 or 18%), military training related explosion (n = 15 or 17%), home explosive device (n = 8 or 9%) and fireworks explosion (n =1 or 1%). Maxillofacial injuries were the most common injury (n=78) followed by upper extremity orthopedic (n=68), head injury (n=32), abdominal (n=30), lower extremity orthopedic (n=29) and thoracic (n=19). The majority of patients with head injury (28 of 32 or 88%) presented with a GCS of 15. CT scans on admission were initially positive for brain injury in 14 of the 28 patients (50%). Seven patients (25%) who did not have a CT scan on admission had a CT performed later in their hospital course due to mental status change and were positive for TBI. Three patients (11%) had a negative admission CT with a subsequently positive CT for TBI over the next 48 hours. The remaining 4 patients (14%) were diagnosed with skull fractures. All patients (n=4) with an admission GCS of <8 died from diffuse axonal injury. **Conclusions**: Blast injury is a complicated disease process which may evolve over time, particularly with TBI. The missed injury rate for TBI in patients with a GCS of 15 was 36%. More studies are needed in the area of blast injury to better understand this disease process.

A PROMISING NEW ALTERNATIVE FOR THE RAPID REVERSAL OF COUMADIN COAGULOPATHY IN TRAUMATIC INTRACRANIAL HEMORRHAGE

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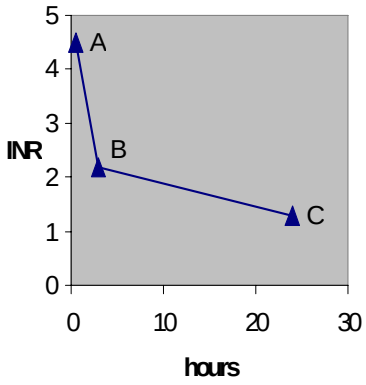
Objective: To determine whether the early use of Factor IX Complex (FIXC) is a safe, faster alternative to current therapy for the rapid reversal of coumadin anticoagulation in patients with traumatic intracranial hemorrhage (TIH).

Methods: FIXC has been used to correct coagulopathy in hemophiliac and internationally in non-hemophiliac patients. A retrospective chart review was conducted for all patients with TIH presenting to our Level I urban trauma center and treated with FIXC between 11/02 and 1/06. FIXC was given upon diagnosis, prior to fresh frozen plasma (FFP) infusion. Data collected included dose and timing of FIXC, effect on clinical coagulation, serial international normalized ratios (INR), dose and timing of FFP, early adverse events, length of stay, and patient outcome.

Results: Twenty patients met criteria. Mean age was 77 years and 9 were female. Mean INR on admission was 4.5 (Figure, point A) and after FIXC infusion, reduced significantly to 2.2 (point B, p=0.006), and remained low for 24 hours (point C). For all patients, the mean time to documented correction was 142 minutes. Of the 5 patients who had repeat INR drawn within 30 minutes after FIXC infusion, the mean time to correction was 15 minutes. After initial aggressive care, 6 patients were made do not resuscitate (DNR) and expired. The overall mortality rate was 35%. There were no early thrombotic events or allergic reactions.



Conclusion: FIXC is safe and effective for rapidly reversing coumadin anticoagulated patients with TIH and should be considered as an alternative treatment to FFP and recombinant Factor VIIa. A prospective randomized trial is needed to confirm its benefits.

A NON-PROTOCOL BASED TRAINING REGIMEN FOR ICP MONITOR PLACEMENT BY GENERAL SURGERY RESIDENTS RESULTS IN HIGHER NON-HEMORRHAGIC COMPLICATION RATES

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BACKGROUND: Limitations in neurosurgical resources have led to an interest in training non-neurosurgeons in the placement of intracranial pressure (ICP) monitors. Our institution's coverage is provided by private neurosurgical attendings, and general surgery residents first-assist neurosurgical staff with interventions for TBI while rotating on the trauma service through all stages of training. Until late 2002, this regimen resulted in senior general surgery residents being allowed to place non-ventriculostomy ICP monitors independent of direct supervision after discussion of the case with the attending neurosurgeon. This study retrospectively examined the safety and efficacy of this non-protocol based training system for the instruction of general surgery residents in ICP monitor placement. **METHODS**: Our trauma database was queried for all patients who had an ICP monitor placed between 4/1/92 and 3/31/03. Ventriculostomies were excluded. Remaining charts were reviewed for age, gender, presenting Glasgow Coma Scale (GCS), injury mechanism; date, time, and hospital location of bolt placement; number of monitored days, patient outcome, nonhemorrhagic complications, and participating personnel. One-way ANOVA was used to compare the mean of numerical variables. Chi square was used to compare categorical variables. Significance was set at $p \leq 0.05$. **RESULTS**: Three groups were identified: those in whom neurosurgery staff (NS) were present at the time of bolt placement (39 bolts in 37 patients), those bolts placed by general surgery (GS) residents independently (31 bolts in 28 patients), and those in whom an attending presence at the time of resident bolt placement was unable to be ascertained (UA) (62 bolts in 59 patients). All groups were similar in age, gender, mechanism, initial GCS, bolt-days, and mortality. Nonhemorrhagic complication rates in GS (19%) and UA (19%) were significantly higher than the NS group (0%) ($p=0.0093$). **CONCLUSION**: An informal training regimen for bolt placement by nonneurosurgeons results in higher rates of nonhemorrhagic complications, and should not be promulgated.

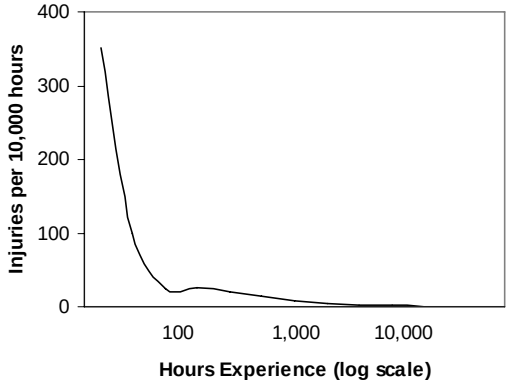
EQUESTRIAN INJURY PREVENTION EFFORTS NEED MORE ATTENTION TO NOVICE RIDERS

John Mayberry,MD*, Tuesday Pearson, BS, Kerry Wiger, RN, Richard Mullins, MD*, Brian Diggs, PhD

Introduction: Equestrian injury is commonly seen at trauma centers and the severity of injury is often high. We sought to determine the risk, incidence, and the influence of skill and experience on injury during horse-related activity.

Methods: Members of horse clubs and individual equestrians in a three-state region were recruited via mailings and community advertisements to take a survey regarding their horse contact time and injuries over their entire riding career. Serious injury (SI) was defined by hospitalization, surgery or long-term disability.

Results: 679 equestrians with a median age of 44 years reported a median of 20 hours of horse contact per month with a mean of 24 years (1 to 75 years) experience. The cumulative risk of any injury (AI) was 81% and of SI was 21%. The incidence of AI and SI were 1.6 ± 0.1 (SE) and 0.26 ± 0.02 per 10,000 hours, respectively. The incidence of injury was 7.6 ± 2.7, 2.4 ± 0.2, 1.5 ± 0.1, and 1.0 ± 0.1 at novice, intermediate, advanced, and professional levels, respectively ($p<.001$, ANOVA). There was a sharp decline in incidence of injury between 18 and 100 hours of experience.



Conclusion: 1 in 5 equestrians will be seriously injured during their riding career. Novice riders have a three-fold higher incidence of injury than intermediates and a five-fold higher incidence than advanced riders. Approximately 100 hours of experience are required to achieve a substantial decline in injury incidence. These findings suggest that equestrian injury prevention efforts need more attention and should focus on novice equestrians.

DOES HELMET TYPE IN MOTORCYCLE CRASHES AFFECT THE INCIDENCE OF TRAUMATIC BRAIN INJURY AND DEATH?

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Objective: To determine the relationship between helmet use and the specific type of helmet as related to the presence and severity of traumatic brain injury (TBI) after a motorcycle crash (MCC).

Methods: Retrospective review of all victims of motorcycle crashes presenting to the trauma service for whom information about helmet usage was available at the time of admission to a Level I trauma center. Patients were identified through the trauma registry, patient charts, & morbidity/mortality records. Demographic data, type of helmet, incidence of TBI, Glasgow Coma Scale (GCS), and mortality were recorded.

Results: For a 10-year period, 260 patients (90%) who sustained injuries after a MCC were helmeted and 30 (10%) were not. TBI occurred in 45 patients (15%), and included 33 helmeted patients (13%) and 10 unhelmeted patients (33%) ($p = 0.005$). Overall mortality was 10% (#30) and included 21 helmeted patients (8%) and 9 unhelmeted patients (30%) ($p < 0.002$). The type of helmet was documented in only 37 patients (14%), with 29 (78%) classified as full head coverage (FC) and 8 (22%) as partial head coverage (PC). In the FC group, the incidence of TBI was 17%, mean GCS was 14, and mortality was 14% as compared to the incidence of TBI of 50% ($p < 0.02$), mean GCS of 8 ($p < 0.0002$) and mortality of 50% ($p = 0.01$) in the PC group.

Conclusions: 1) TBI and deaths continue to occur with increased frequency in unhelmeted vs. helmeted motorcyclists. 2) The incidence and the magnitude of TBI are significantly increased in motorcyclists wearing PC helmets as compared to those wearing FC helmets. 3) Compared to the use of a FC helmet, use of PC helmet significantly increases the risk of mortality in motorcycle crash victims.

THE IMPACT OF SAFETY BELT USE ON LIVER INJURIES IN MOTOR VEHICLE CRASHES: CRASH INJURY RESEACH AND ENGINEERING NETWORK DATA SUPPORT THE IMPORTANCE OF MOTOR VEHICLE SAFETY SYSTEMS.

Troy Lisa Holbrook, M.S., Ph.D., David B. Hoyt, M.D.*, A. Brent Eastman, M.D.*, Micheal Sise, M.D.*, Frank Kennedy, M.D.*, Tom Velky, M.D.*, Carol Conroy, MPH, Ph.D., Sharon Pacyna, RN, BSN, MPH, Steve Erwin

Background: Liver injuries (LI) are one of the most serious and common consequences of motor vehicle crashes (MVC). In the unstable patient, early detection of LI based on clinical suspicion will improve acute trauma care and outcomes. The specific objectives of this analysis are to identify crash scene and occupant risk factors for LI from MVC.

Methods: Crash Injury Research and Engineering Network (CIREN) data were used to identify risk factors for LI; age, sex, safety belt use, air bag deployment, Delta V (change in velocity), principal direction of force (PDOF), vehicle crush and intrusion. Occupants with LI were compared to 4 control groups ***without*** LI; (1) No abdominal (ABD) injury (NO_ABD), (2) Any ABD (ANY_ABD), (3) ABD AIS of 1-2 (ABD_1-2), and (4) ABD AIS 3+ (ABD_3+). LI occupants were compared to each control group and odds ratios (OR) for risk of LI were computed.

Results: There were 311 CIREN subjects aged 5+ with LI. The total mean ISS was 37.6. LI was strongly and significantly associated with safety belt restraint use ***without*** air bag deployment, compared to each control group, shown below in the Table.

LIVER INJURY VS. NON-LIVER INJURY CONTROL GROUPS

Restrained + Airbag *Not* Deployed	NO_ABD (N=1519) OR	ANY_ABD (N =317) OR	ABD_1-2 (N = 155) OR	ABD_3+ (N = 217) OR
***P < 0.001	4.4***	2.6***	3.1***	2.4***

This association was independent of driver/passenger status and PDOF. LI were also strongly and significantly associated with higher Delta V crashes, and greater vehicle interior intrusion and exterior crush.

Conclusions: Liver injuries were strongly associated with a safety belt restraint in use *in the absence of air bag deployment* during MVC. This data has profound importance to the trauma surgeon as an early indicator for LI during resuscitation. These findings also have important implications for future research efforts to improve safety systems in motor vehicles and reduce morbidity and mortality from MVC in the United States.

CAUSES OF DEATH IN SPECIAL OPERATIONS FORCES ON THE MODERN BATTLEFIELD: 2001-2004

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Objectives: Effective combat trauma management strategies and tactics depend upon an understanding of the epidemiology of injury & death on the battlefield and identifying those areas wherein improvement can be made. Advances in civilian trauma management parallel those made in the management of combat casualties.

Methods: De-identified autopsy and treatment records of all Special Operations Forces (SOF) fatalities (combat and non-combat) from Afghanistan & Iraq from October 2001 to November 2004 were reviewed by a multidisciplinary group including forensic pathologists, combat medics, and military and civilian trauma surgeons. Deaths were classified as potentially survivable against a standard of US urban Level I trauma center care. A 15 point questionnaire provided a structured tool for improvements in equipment, training, research and care systems.

Results: There were 82 SOF fatalities with 77 autopsies available. Eighty-four percent (65/77) of the fatalities were non-survivable (ISS = 58 ± 35) while 16% (12/77) were potentially survivable (ISS = 35± 9), $p < 0.05$. In these 12 patients, there were 15 distinct causes of death; non-compressible hemorrhage (7/12), hemorrhage amenable to placement of a tourniquet (3/12), airway (2/12), compressible hemorrhage not amenable to tourniquet placement (2/12), tension pneumothorax and sepsis (1/12) each. The most common mechanism of potentially survivable death was from gun shot wounds (7/12). Twenty-five areas were identified wherein improvement of care could have influenced outcome.

CONCLUSION:

Multi-system trauma predominates in combat injury with over 84% being irretrievably fatal under any circumstance. Prehospital opportunities exist to further prevent death by more rapid access to definitive surgery or new products for non-compressible bleeding. Current ISS scheme fails to capture magnitude of combat injuries. Further research should be directed at preventing death from non-compressible hemorrhage.

Prioritizing Trauma Prevention Efforts: The University of Tennessee's Trauma-Related Injury Prevention Score

Jose G. Christiano, MD, Blaine Enderson, MD*, Brian Daley, MD

Background: Communities across the country struggle to raise money for prevention of trauma-related injuries (TRI) and then face the challenge of identifying where to assign it. Trauma centers have the responsibility to provide local authorities with data to be used when prioritizing trauma prevention efforts. **Objective**: To create a mathematical ranking method for TRI that assesses their impact on the community and can be used by local authorities planning trauma prevention initiatives. **Methods**: Data of the 14,605 trauma patients admitted to our Level 1 Trauma Center from 2000 to 2004 were retrieved from the local trauma registry to be used as the comparator database. Mechanisms of injury (MOI) were categorized according to ICD-9 E-Codes and grouped by similarity. Each group in the year of 2004 (3,157 patients) was then ranked using our Trauma-Related Injury Prevention (TRIP) Score, which standardizes frequency (Freq), mortality (Mort), and length of hospital stay of the survivors (LOSs) for each MOI.

Mechanism	TRIP	Freq z	Mort z	LOSs z
1. MVA	83.50	5.6877	0.2975	0.2177
2. GSW	62.09	0.1694	1.9041	0.1653
3. Fall	62.07	2.1483	0.0370	0.0505
4. Suicide	59.30	-0.2166	1.2161	0.7233
5.Pedestrian	57.54	-0.0784	0.5136	0.9619

Findings: Limited overall ranking of MOI is shown on the table above. Rankings also varied across age groups. There was variable contribution of each component of the TRIP Score (overall and by age groups), showing the need for targeted prevention approaches. **Conclusions**: Local communities can use the TRIP Score as a quantitative method to rank TRI when planning and prioritizing trauma prevention efforts. The components of the TRIP Score provide valuable additional information and amplify the power of the tool. Results confirm that traumatic profiles vary according to age, calling for different prevention strategies across age groups.

ADMISSIONS FOR GUNSHOT WOUND INJURIES FOLLOWING A STATEWIDE CONCEALED FIREARMS LAW

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Background: Optimal methods to reduce firearm related injuries are constantly sought. The impact of firearm legislation on injuries is consequently of interest. We sought to examine the effect a new statewide concealed firearms law on gunshot wound (GSW) admissions in an urban county. **Methods**: GSW admissions to the two ACS verified Trauma Centers in a single county (Level I & II) over a 2 year period were identified from the respective trauma registries. The first 12 month period (PRELAW 4/2003–3/2004) was prior to the enactment of a law permitting qualified adult citizens to carry a concealed weapon. The law was in effect in the second 12 month period (POSTLAW 4/2004 – 3/2005) Patient demographics in these two periods were compared using student t-test and Fisher's exact test. **Results**: In the PRE-LAW period there were 192 GSW admissions with 30 deaths (19 homicides, 10 suicides). In the POST-LAW period there were 182 GSW admissions with 24 deaths (15 homicides, 8 suicides) No statistically significant differences were found in age, number of deaths, ISS, male/female ratio or unintentional injuries. **Conclusion:** In a 12 month period following the introduction of a concealed weapons law, there was no difference in the number of trauma admissions, anatomical sites of injury, suicides, homicides or unintentional injuries in an urban county. These results are consistent with prior studies demonstrating the firearm legislation do not necessarily correlate with firearm deaths. Effective preventative methods to curb the high firearm injury rate in the US need to be continuously explored.

	PRE-LAW	POST-LAW	P value
Age	31.2 ± 13.18	32.5 ± 13.96	0.85 NS
GSW/month	16	15.2	0.57 NS
ISS	9	10.4	0.16 NS
Male/female	167/24	162/20	0.75 NS
Suicide	10	8	0.81 NS
Homicide	19	15	0.59 NS
Unintentional Injuries	14	22	0.16 NS
Head Injuries	42	40	0.71 NS
Torso Injuries	92	85	0.84 NS
Ext. injuries	109	100	0.75 NS

INCIDENCE AND CRASH MECHANISMS OF AORTIC INJURY OVER THE PAST DECADE

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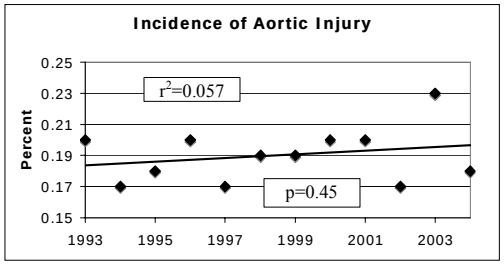
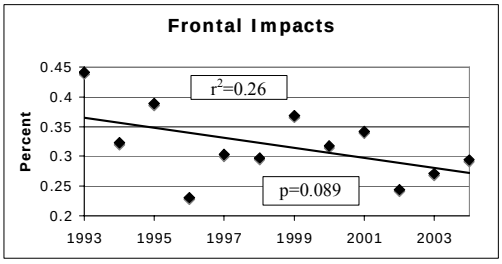
Introduction: Aortic injuries were traditionally thought to be the result of severe frontal crashes. Newer data has suggested other crash types such as nearside crashes may also be important in aortic injury. We hypothesized the implementation of recent safety measures would decrease the incidence of aortic injury associated with motor vehicle crashes.

Methods: The autopsy reports of all traffic fatalities for motor vehicle occupants in a large urban county for the years 1993 to 2004 were examined. The demographics, impact types, safety measures used, and the presence of any aortic injury was recorded. Trends were evaluated for significance by weighted linear regression.

Results: The incidence of aortic injury associated with fatal motor-vehicle crashes has remained unchanged over the past 12 years. Since by law all traffic related deaths in our county are referred to the medical examiner this represents the true incidence of aortic injury in this population. There is a trend towards decreased aortic injuries associated with frontal crashes but no change in nearside or farside crashes. This is despite an increase in seat belt use and increased presence of airbags over the same time period.





Conclusions: Despite improved safety measures designed to minimize the occurrence of aortic injuries, the incidence of blunt aortic injury has not decreased over the past decade. Although not statistically significant, there is a trend towards decreased frontal crashes associated with aortic injuries. The nearside crash mechanism continues to play a prominent role, and efforts at improving vehicle safety should be focused on crash mechanisms as they relate to aortic injury.

Increased fatalities following Motorcycle Helmet law repeal in Florida, is it all due to lack of helmets ?

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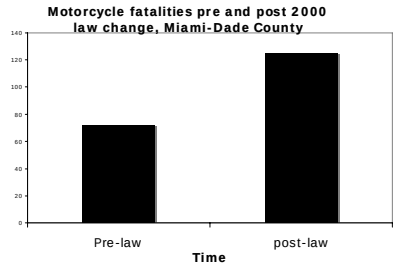
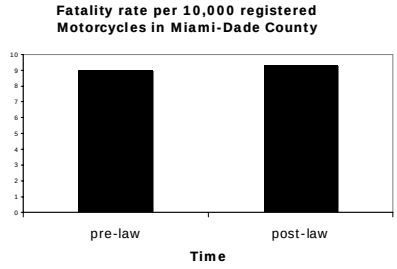
Background: More motorcycles have been sold in the past four years (2000-2004) than in the entire preceding decade. The 39% national increase in fatalities observed over this time may be due to an increase in riders, or because the number of states with universal helmet laws has decreased from 47 in 1975 to 21 in the present day. We examined the effect of the repeal of Florida's helmet law in July 2000 to test the hypothesis that the increase in fatalities is not explained by an increase in the number of motorcycle rider.

Methods: We identified all motorcycle fatalities (N=197) in Miami-Dade county, Florida's most populous county, for a three and a half year period prior to repeal (pre-law), and a similar period after repeal (post-law), using Police crash reports and Medical Examiner records. The impact of the repeal was measured by comparing fatalities, helmet use, and number of registered motorcycles in the two time periods.



Results: There was a decrease in helmet use in fatal crashes from 92% to 50%, and an increase in motorcycle fatalities following repeal; 72 to 125 (Fig 1). However, the repeal was associated with a sharp rise in annual motorcycle registrations from 17,270 to 39,043. Fatality rates adjusted for number of registered motorcycles did not change; 9.0 deaths per 10,000 motorcycles pre-law, and 9.3 deaths post-law (Fig 2).



Conclusions: There was a significant rise in motorcycle fatalities following Florida's helmet law repeal, but the association is multi-factorial, and cannot be attributed solely to a decrease in helmet use, without consideration of an increased number of riders. The dual consequences of helmet law repeal of increasing motorcycle numbers in addition to decreased helmet use should be taken into consideration prior to legislative changes.

TRENDS IN FIREARM-RELATED INJURIES REQUIRING HOSPITALIZATION IN NEW YORK STATE: 1998-2004

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Background: Firearm-related injuries (FRI) are a substantial burden to the health care system. We investigated trends in hospitalizations for FRI in New York State in order to access the effectiveness of current strategies aimed at both preventing and treating these injuries.

Methods: Patients hospitalized after trauma during the years 1998-2004 were abstracted from the New York State Statewide Planning and Cooperative Systems Database. Annual FRIs, demographics of injured patients, hospital length of stay (LOS) and mortality were compared.

Results: Between the years 1998 and 2004, there were 11,211 hospitalizations for FRIs in New York State, compromising 1.8% of all trauma admissions. Hospital charges for these injuries averaged $35,853,780 annually, $22,168 per patient, and were significantly higher than mean charges per patient for other injuries ($18,174, $p<0.001$). Among patients admitted with a FRI, the mean age was 27.1 years, 92.1% were male, 86.2% were of minority race, and 35.0% lacked health insurance. Over the 7-year study period, there was no significant change in total number of FRIs, the percentage of trauma admissions related to firearm injuries, or the demographics of patients hospitalized for FRIs. Furthermore, mean hospital LOS (7.0 days) and mortality (6.4%) did not improve.

Conclusions: Neither the prevention nor the treatment of FRIs requiring hospitalization improved over the 7-year study period. Persistent firearm violence, socioeconomic disparities associated with FRIs, and financial strain on the health care system, particularly those facilities caring disproportionately for minorities and the uninsured, underscore the urgent need for an increase in targeted preventive measures.

HIGH MORTALITY IN ELDERLY DRIVERS IS ASSOCIATED WITH DISTINCT INJURY PATTERNS: ANALYSIS OF 187,869 INJURED DRIVERS

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Introduction: Higher mortality in elderly drivers involved in motor vehicle collisions (MVCs) is a major concern in an aging population. We examined age-related differences in injury severity, outcome, and patterns of injuries using National Trauma Data Bank records of 187,869 drivers, of which 15,755 were elderly (70+) injured from 1994-2003.

Materials & Methods: Injury severity scores (ISS) and measures of outcome were compared amongst five age groups (<26, 26-39, 40-54, 55-69, 70+yo) using chi-squared tests and analysis of variance. ICD-9 codes were used to compute the frequency of specific injuries across groups. Stratification by restraint usage was used to control for age-related differences.

Results: After age 25, injury severity, mortality, and length of stay (LOS) all increased progressively with age, while likelihood of discharge home decreased for each group ($p<0.001$). Restraint use increased with age. However, age-related adverse outcomes were significantly increased even after adjusting for restraint use ($p<0.0001$). Unrestrained elderly drivers had the highest mortality (16%) and morbidity (mean ISS=15; LOS=10 days), and were least likely to be discharged home (40%). AIS scores and ICD-9 codes indicated that poor outcomes with age were driven primarily by head and chest injuries, especially intracranial hemorrhage, rib fractures, pneumothorax, and injury to the heart and lungs.

Conclusion: Elderly drivers involved in MVCs have disproportionately poor outcomes primarily due to a greater incidence of head and chest injuries. Seatbelt and airbag use in elderly drivers significantly reduce this trend but do not eliminate it. These observations should spark a national discussion regarding driver education, re-licensure, and vehicle design.

TRAUMATIC SUICIDE ATTEMPTS: FACTORS INFLUENCING MECHANISM AND OUTCOME

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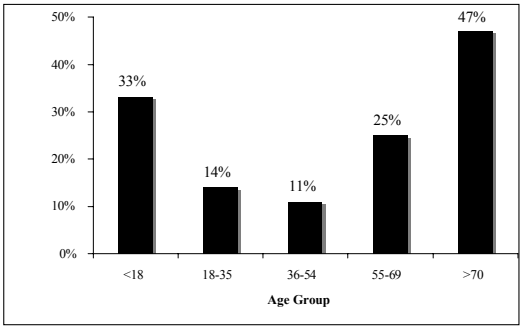
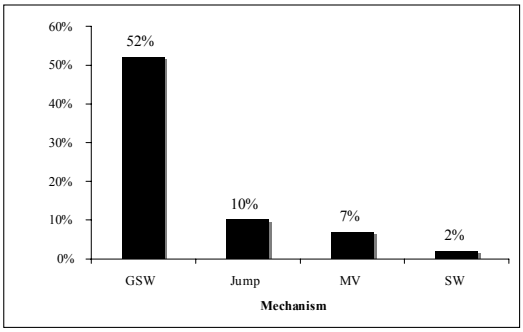
Background: The purpose of this study is to investigate traumatic suicide attempts (TSA) stratified by age and mechanism of injury.

Methods: Retrospective review of TSA patients (identified by E-code) admitted to our urban, level I trauma center from 1992 to 2005. Mechanisms of TSA included jump from height, firearm (GSW), cutting/piercing instrument (SW), and motor vehicle related (MV). Patients were categorized in groups by age in years (<18, 18-35, 36-54, 55-69, ≥70).

Results: There were 876 TSA patients identified (83% male, 35 years old, ISS=10). The most common mechanism was SW (39%) followed by jump (26%), GSW (21%), and MV (13%). Primary mechanism of TSA varied by age ($p<0.0001$), with GSW most common in those patients <18 (64%) and ≥70 (44%) and SW most common in all other age groups. Overall, 15% of TSA were successful, but mortality rate depended on age ($p<0.0001$) and mechanism ($p<0.0001$).





The strongest independent risk factors for mortality after TSA were age ≥ 70 [odds ratio: 12(95%CI:2-78), p=0.001] and using a firearm [odds ratio: 9(95%CI:3-44), p=0.005].

Conclusions: The most common mechanism for TSA was SW, though GSW was the most effective. Mechanism of choice for TSA depends on age, with the extremes of age more commonly choosing a firearm. Success of suicide attempt is dependent on age and mechanism of injury.

EPIDEMIOLOGY OF RURAL VS. URBAN TRAUMA DEATHS IN NEW MEXICO

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Objective: To compare population-based data on trauma deaths between rural and urban counties within a single statewide trauma system.

Methods: A retrospective cohort study examined all traumatic deaths of New Mexico residents reported to the state's Office of the Medical Examiner (OMI) for the last census year, 2000. Deaths of residents from the one urban county were compared against those of the other rural counties. We also analyzed the deaths comparing an urban vs. rural geographic location of injury. Data collected from the OMI included mechanism of injury, manner of death, cause of death, location of injury and death, presence of alcohol and or drugs in the body, and time from injury to death. Demographic data were collected from both the OMI and US Census Bureau.

Results: 1017 cases met inclusion criteria. The annual incidence of fatal injuries occurring in rural counties was 58.46 per 100,000 residents vs. 50.12 per 100,000 for urban, with a relative risk of 1.17. Accidents were the leading manner of death for both urban and rural residents, 62.1% and 53.8% respectively, but homicide and suicide occurred more commonly amongst urban residents, ($p=0.44$). Fatal penetrating injury was more common in urban deaths than rural, 33.8% vs. 23.8%, ($p<0.001$). Overall, 90% of fatal rural injuries died outside of the Level I Trauma Center, with 43.2% of rural deaths occurring on scene vs. 26.8% for urban, ($p<0.001$). Overall, only 17.4% of both urban and rural deaths occurred within the first hour of injury.

Conclusion: The epidemiology of traumatic death significantly differs between rural and urban settings. Most rural trauma deaths occur without the care of a Level I Trauma Center. This illustrates the need for more aggressive transport systems as well as for better prevention measures within rural settings.

FIREARM SUICIDE: THE USE OF A FIREARM INJURY AND DEATH SURVEILLANCE SYSTEM

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Background: Suicide is an important public health concern. Nearly twice as many Americans die annually of suicide than homicide. Firearms are the most common means used in suicide deaths. This study describes the epidemiology of both fatal and non-fatal suicide attempts using firearms in one metropolitan city/county area during the three year period of 2002-2004 using a population based, cross-sectional surveillance system.

Methods: Records of all victims of firearm injuries were obtained from six hospitals, police agencies, and the coroner's office. The data was matched to ensure an unduplicated count of victims. All injuries categorized as intentional self-inflicted/suicide were included.

Results: We identified 200 cases of attempted firearm suicide. Age-adjusted rates compared to state and national rates are shown in the table. Gender of victims was 84% male and 16% female. Victim's race was 79% white, 17.5% black, and 2.5% Hispanic. No significant seasonal pattern was observed. Firearms used included handguns(72%), shotguns(18%), and rifles(6%). 173(86%) victims died of their injuries. 126(63%) died at the scene. Of the 74 victims treated, 64% subsequently died. The majority of wounds were located in the head(68%), followed by chest(17.5%), and face(5.5%). Mental illness or relationship problems were common stressors. Most suicides occurred in a residence.

Age	City/County(2002-2004)		State(2003)	p-value		United States(2003)	p-value
15-24	*†8.47(per 100,000)		*4.89	*0.003		†4.97	†0.004
25-34	†12.96		10.68	0.162		†5.97	†<0.001
35-44	†10.45		8.57	0.192		†6.58	†0.002
45-54	8.74		10.11	0.417		8.04	0.642
55-64	10.08		9.32	0.714		8.3	0.362
65 +	3.53		8.37	n/a		10.7	n/a

Conclusions: Through collaboration with multiple local hospitals, law enforcement, and the coroner's office, we developed an effective system for monitoring firearm injuries in our metropolitan area. This surveillance identified that firearm suicide rates for young adults in the city/county area significantly exceed state and national rates. We are currently using this system to support and evaluate community injury prevention efforts.

AGREEMENT BETWEEN PRE-HOSPITAL AND EMERGENCY DEPARTMENT GCS COMPONENT SCORES

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Purpose: A significant correlation between pre-hospital (PH-GCS) and emergency department GCS (ED-GCS) scores has been reported. However, agreement between individual components of the PH-GCS and ED-GCS has not been assessed. The current study examined which Ph-GCS components (motor, eye or verbal) have better agreement with equivalent components of ED-GCS. **Methods:** For the study period January 1 2000 through December 31 2001, EMS patient care records were linked to our institution's trauma registry. Head injuries were categorized according to Ph-GCS score: 13-15, mild; 9-12,moderate; and 3-8, severe. Kappa coefficients were used to examine the agreement between head injury classification as determined by Ph-GCS and ED-GCS scores. **Results:** In total, 898 subjects were included in the study. By Ph-GCS head injury category: mild (N=769), moderate (N=72), and severe (N=57). Agreement was good for the mild (97.2%) category but poorer for moderate (14.1%) and severe (49.0%) groups. Overall, the Kappa coefficient was 0.3839, $p < 0.001$, indicating moderate agreement. By GCS component, Kappas were similar, ranging from 0.2688 (motor) to 0.2804 (eye), for all $p < 0.0001$.

Agreement between PH-GCS and ED-GCS severity group

	PH-GCS Group		
ED-GCS Group	Mild (%)	Moderate (%)	Severe (%)
Mild	*97.2*	77.5	41.2
Moderate	1.2	*14.1*	9.8
Severe	1.6	8.5	*49.0*

Kappa coefficients between PH and ED by GCS component

		Transport time (minutes)	
GCS Component	Overall	<20	≥20
Eye	0.2804	0.3280	0.1990
Verbal	0.2893	0.2982	0.2320
Motor	0.2688	0.2977	0.1246

Kappa values were much lower in the group that took ≥ 20 minutes to transport. **Conclusions:** PH and EDGCS components' agreement was moderate. The motor component had the poorest agreement of any component. Results suggest that PH-GCS scores tend to be conservative and improve by time of ED admission.

PATTERNS OF INJURY IN PEDIATRIC PENETRATING TRAUMA

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Background: Trauma is the leading cause of death and disability in pediatric patients. The purpose of this study is to investigate injury patterns and outcomes of pediatric patients after penetrating trauma.

Methods: Retrospective review of all pediatric (< 18 years old) patients who sustained penetrating trauma and were admitted to our urban, level I trauma center from 1992 to 2005. Demographics, injury patterns, procedures, and outcomes were recorded. Younger patients (<14 years old) were compared to older patients (14-17 years old).

Results: There were 1,918 patients identified (90% male, 15 years old, 83% gunshot wound, 17% stab wound, GCS=14, ISS=11). Overall, 1,101 (57%) patients required surgical intervention, 365 (19%) required laparotomy, 137 (7%) underwent a vascular procedure, 67 (3%) required thoracotomy, and orthopedic procedures were performed in 66 (3%) patients. There were 254 deaths, for a mortality rate of 13%. Three hundred seventy seven (20%) patients were younger than 14 years. Younger patients were more often female (21% vs. 7%, $p<0.0001$) and sustained more stab wounds (24% vs. 15%, $p<0.0001$). Younger patients had more intracranial injuries (12% vs. 8%, $p=0.03$), but fewer lower extremity fractures (2% vs. 5%, $p=0.02$) or vascular injuries (0.5% vs. 2%, $p=0.02$) and fewer abdominal visceral (12% vs. 16%, $p=0.04$) or vascular (2% vs. 5%, $p=0.05$) injuries. Despite different injury patterns, there was no difference ($p=0.16$) in mortality between younger (16%) and older (13%) patients.

Conclusions: Penetrating injuries in pediatric patients are usually due to gunshot wounds, frequently require operative intervention, and are associated with an overall high mortality rate. Younger patients sustain more head injuries but fewer lower extremity and abdominal injuries. However, there is no difference in mortality between younger and older children following penetrating injury.

ACUTE MANAGEMENT OF HAEMODYNAMICALLY UNSTABLE PATIENTS WITH A PELVIC FRACTURE; A MULTICENTRE REVIEW OF RECENT PRACTICE

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Background: Haemorrhage-related mortality (HRM) of pelvic fractures continues to challenge trauma care. This study describes the management and outcome of haemodynamically unstable pelvic fracture patients with emphasis on primary intervention for haemorrhage control and HRM. **Methods**: Blunt trauma patients (ISS≥16) with a major pelvic fracture (AIS pelvis ≥3) and haemodynamic instability (admission systolic (SBP) ?90 mmHg or receiving ≥ 6 units of blood (PRBC) /24 hours) were included into a 48-month (ending in December 2003) multi-centre retrospective study of eleven Level-1 trauma centres. Data are presented as mean±sd. *p<0.05 based on ANOVA or Chi-square. **Results**: 217 patients (mean age 41±19 years, 71% male and ISS 42±16) were studied. The admission SBP was 96±37 mmHg and GCS 11±5. Patients received 4±2 L fluids including 4±4 U PRBCs in ED. Sixty-nine patients (32%) died, the HRM was 19%, 29% of HRM was of pelvic origin. 120/217 (55%) patients had FAST or DPA/DPL and 60/217 (28%) had pelvic binding in ED. 53/109 (49%) patients had no bleeding noted at laparotomy and 26/106 (25%) had no abdominal findings, 15/53 (28%) had no prior abdominal investigation (FAST/DPL/CT). Angiography rate was positive in 48/58 (82%).

Primary intervention	N	ISS	Age	SBP (mmHg)	ED PRBC(U)	24hr PRBC(U)	HRM (%)
Angiography	34	42±16	49*±23	100±39	5±5	19±20	18
Laparotomy	58	45±15	40±20	89±38	4±4	18±12	29*
Pelvic Fixation	29	33*±11	42±14	109*±33	3±3	14*±9	10
Laparotomy/ Fixation	44	47*±15	36*±14	92±35	5±4	22±12	16
No intervention required	52	38±16	43±19	97±36	3±4	7*±5	10

Conclusion: The HRM of major pelvic trauma is unacceptably high especially in the primary laparotomy group. Non therapeutic laparotomies need to be avoided concentrating instead on arresting pelvic haemorrhage. Evidence based clinical practice guidelines should be implemented to optimise care.

THROMBOEMBOLIC COMPLICATIONS ASSOCIATED WITH FACTOR VIIA ADMINISTRATION

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Objective: Factor VIIa (FVIIa) is given to promote hemostasis in coagulopathic trauma patients at high risk for death (J Trauma 57:709). FVIIa is associated with thromboembolic complications (JAMA 295:293), but the incidence is not known, nor which patients are at risk. We examined our experience with FVIIa to better delineate this issue.

Methods: Medical records of patients who received FVIIa in our center between 6/2001 – 2/2006 were reviewed for evidence of thromboembolic events (ischemic CVA, myocardial ischemia or infarct, mesenteric infarct, peripheral arterial thromboembolism, deep venous thrombosis or pulmonary embolus). Indication for dosing, timing of complication, and clinical outcome were recorded. Each event was assessed by a panel of experienced clinicians to determine the contribution of FVIIa to the event and to patient outcome.

Results: 265 medical records were reviewed. 23 patients (8.7%) had thromboembolic complications following FVIIa. Types of events and the judged likelihood that FVIIa contributed to the event are shown in the table. Eight events were thought to be highly related to FVIIa, and 12/16 deaths were, in part, due to the thrombotic complication. Thirteen of the events, including all CVAs and all cases of mesenteric ischemia, were attributed to a combination of FVIIa and a definable, high-energy vascular injury.

Complication	N	Low Prob.	Med.Prob.	High Prob.	Died
Cerebral Infarct	5	4	1		3
Myocardial Event	3		1	2	2
Mesenteric Infarct	8	5	1	2	8
Other	7	2	1	4	3

Conclusion: FVIIa is a potent pro-coagulant, with the potential for thromboembolic adverse events in susceptible patients. Our experience suggests that caution should be exercised in administration of FVIIa to patients with arterial injuries. The injured mesenteric and cerebral vasculature may be particularly susceptible to thrombosis.

A SUCCESSFUL ENTERAL TUBE PLACEMENT PROTOCOL AND ITS IMPACT ON HOSPITAL COSTS

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Objective: To review the effectiveness of a previously studied naso-enteric feeding tube placement protocol on every day practice of a Surgical Nutrition Service and note impact on cost savings.

Methods: We developed and tested a protocol to place naso-enteric feeding tubes. Patients were given a prokinetic prior to placement of the tube. All other nasal tubes were removed. A 10-French, non-weighted, styletted feeding tube measuring 110cm was placed in the nostril and advanced to 65 cm. Air was pushed in the tube and heard in the stomach. A gastric aspirate was obtained. Then the tube was advanced slowly rotating it clockwise with intermittent irrigation of 20 mL of water. Air was pushed in the tube and the sound followed down the upper GI tract. When the air was heard coming from the tube in the right flank or upper quadrant area (about 80-85 cm of tube inserted), an aspirate was taken to compare to the gastric aspirate. Change in the position of the air sound in the GI tract and change in the color of the aspirate to a clear and yellow aspirate verified position in the small bowel. Tube placement was verified by abdominal X-ray.

Results: The initial study yielded a success rate of 97% placing the tube transpylorically in 102 patients. This was estimated to save $21,800 in costs to our patients if no X-rays were taken. This protocol was then integrated into the daily practice of the Surgical Nutrition Service. Over the last 7 months, tube placements (174 consecutive tubes) utilizing this protocol allowed us to avoid X-rays in 63 (36%) of the patients for a savings of $13, 860. Of the remaining 111 tubes placed none had the concomitant change in aspirate and required X-rays for verification. Seven (4%) were in the distal stomach and 104 (60%) were placed transpylorically (success rate of 96%).

Conclusion: Although we matched our success rate from our the pilot study to actual daily practice, we were not able to reap the same amount of cost savings as estimated in the original study.

THE IMPACT OF BRAIN CONCUSSION INJURIES: NEW DATA ON QUALITY OF LIFE OUTCOMES AND LONG-TERM DEPRESSION

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Introduction: Little is known about the impact of brain concussion injury (BCI) on short and long-term quality of life (QoL) and psychological outcomes after trauma. Long-term effects of brain concussion injuries are not well understood. A prospective epidemiologic study was conducted to examine multiple outcomes after major trauma, including quality of life, and psychological outcomes including depression (DEPR). The specific objectives of the present report are to examine short and long-term QoL and DEPR associated with BCI.

Methods: 1048 eligible trauma patients were enrolled in the study. Admission criteria for patients were age 18 or older and length of stay (LOS) greater than 24 hours. Functional outcome after trauma was measured using the Quality of Well-being (QWB) scale (range; 0 = death to 1.000 = optimum functioning). Depression was assessed using the Center for Epidemiologic Studies CES-D. Patient outcomes were assessed at discharge, and at 6, 12, and 18 months after discharge

Results: Subjects with brain concussion (N = 235) were significantly more likely to be depressed at discharge compared to subjects without head injury (N = 439); (38% vs. 29%%, Odds Ratio (OR) = 1.5, $P < 0.05$). They were also significantly more likely to have long-term depression (42% vs. 33%, OR = 1.5, $P < 0.05$). QoL outcomes were significantly worse at each follow-up time point in subjects with a BCI and long-term DEPR versus subjects without head injury.

Concussion+DEPR	0.378	.0.549	0.585	0.583
No Head Injury	0.378	0.549	0.585	0.698***

Conclusions: Trauma survivors with BCI are at risk for markedly worse QoL outcomes after trauma than non-head injured trauma survivors. They have higher rates of discharge and long-term DEPR. Differences in trauma outcomes associated with brain concussion have important implications for future studies of recovery from trauma.

Rehabilitation Outcomes: The Good and the Bad

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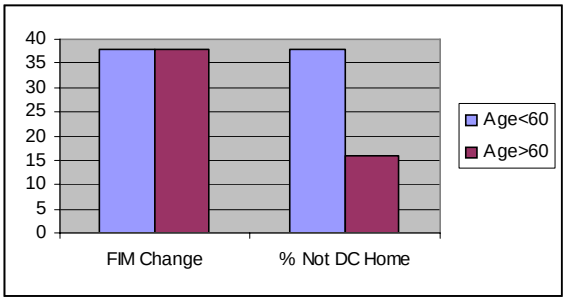
Introduction: While trauma outcomes are classically measured in survival, the quality of that survival is often not fully considered. We planned to explore the effectiveness of our associated rehabilitation hospital compared to national norms and the ultimate disposition of patients admitted there. **Methods:** We reviewed the records of all trauma patients admitted to our associated rehabilitation hospital over a one year period (2005). The hospital is geographically on campus but is a free standing facility, and rehabilitation liaisons and physicians participate in our weekly PI meetings. Collected data included functional independence measure (FIM) scores at entry and discharge, length of stay (LOS), admitting diagnosis and discharge disposition. **Results:** Ninety-six patients were admitted to the rehabilitation hospital from our trauma service in 2005. Admission diagnoses were: Brain Injury 45%, Ortho 23%, Multiple Trauma 13%, and Spinal Cord Injury 19%. The average length of stay was 17 days and average age was 46. 78% of patients were discharged to home, while 9% went to an acute facility, 7% went to a SNF, and 6% went to another rehab. The average FIM gain during the rehabilitation stay was 38 points, significantly greater than the national average of 24 ($p<.05$). The FIM gains were the same for those greater than or less than 60. The location of discharge was highly dependent on age. Of those greater than 60, 11/29 (38%) could not be discharged to home, compared to 11/67 (16%) of those less than 60 ($p\leq.05$). **Conclusion:** Our associated rehabilitation hospital produces increases in FIM scores that are greater than the national average. Despite this, patients older than 60 are much less likely to return home after a traumatic injury, even with equivalent gains in FIM scores. Efforts to improve this disparity will help outcomes for trauma care.



RETHINKING THE CRITERIA FOR ADMISSION IN MINIMALLY INJURED PREGNANT PATIENTS: A NEW PARADIGM?

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PURPOSE: To determine the yield of admission for observation and monitoring in the pregnant victim of trauma who suffers little to no injury.

METHODS: A retrospective database review was performed of all pregnant trauma admissions from January 1, 1995 to December 31, 2005 to our Level 1 trauma center. Only those with Injury Severity Score (ISS) ? 8 were included. Burn patients were excluded. Data gathered included Age, Length of Stay (LOS), Injury Diagnoses, Procedures, ISS and TRISS.

RESULTS: There were 212 pregnant victims of trauma with ISS ? 8. The average ISS was 2.28 and the average TRISS was 0.996. Average age was 26 years. Average LOS was 1.12 days. 31 patients had no documented injuries. None of the 212 required abdominal surgery. 9 underwent fracture fixation. 2 patients underwent emergent cesarean section. The first had an ISS of 4. She had irritability on tococardiographic monitoring and was at term. It was therefore decided to proceed with cesarean section on that admission. The other patient had an ISS of 5 and fetal decelerations on monitoring. At surgery, she was found to have a placental abruption. Both patients had cerebral concussion as their main trauma diagnosis. None of the 123 patients with ISS < 4 required cesarean section. None of the 31 patients without documented injury underwent cesarean section.

CONCLUSIONS: Over an 11 year period, the yield for observation in the context of minor injury (ISS ? 8) is quite low, with only 0.94% of patients requiring cesarean section. However, due to the magnitude of the consequences, monitoring for those injured pregnant patients with ISS ? 4 is indicated. For patients without documented injury, i.e. no discrete injury diagnosis, this study suggests that observation and monitoring may not be indicated. Patients with ISS < 4 may also not require fetal monitoring. This subgroup should be examined in a larger study to corroborate these results.

ARTERIAL BLUSH ON COMPUTED TOMOGRAPHY IS PRIMARY PREDICTOR OF SUCCESS OF NONOPERATIVE MANAGEMENT OF SPLENIC INJURY AND UTILITY OF ANGIOGRAPHY AND EMBOLIZATION REGARDLESS OF GRADE OF INJURY

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BACKGROUND: Non operative management (NOM) of splenic injury in hemodynamically stable adults is increasingly recognized as a viable option. In the past few years, visceral angiography and catheter directed embolization of the splenic artery have emerged as a complementary management strategy to expectant observation. Angiography and embolization are not without risks and are costly procedures, thus non-selective utilization is to be avoided. This study seeks to identify specific findings on CT scan that help to predict which patients are at risk for developing active splenic hemorrhage during NOM and would benefit from angiography and embolization.. METHODS: We searched our trauma registry from July 2004-Sept 2005 (N=1108) to identify patients having splenic injury diagnosis (N=108), splenic surgery (N=39), visceral angiogram and/or embolization (N=43). This yielded a cohort of 149 patients having one or more of the inclusion criteria. All of these patients had CT scans during the first 24 hours of admission. Splenic appearance at CT scan was correlated with surgical findings and hospital course, with specific attention to any patients that had delayed splenic rupture or catheter embolization and subsequent complications of that procedure. RESULTS: We found that vascular blushes on the arterial phase of contrast enhanced CT scans are the best predictors of failed trial of NOM in patients with splenic injury, regardless of the grade of splenic injury. Delayed rupture does not appear to occur in the absence of these blushes, even when the spleen is extensively contused and/or lacerated. CONCLUSION: A splenic vascular blush on post trauma contrast enhanced CT, even when rather small, should lead to strong consideration of visceral angiography and catheter embolization of the splenic artery as a first step in NOM. Severity of splenic disruption alone does not predict failure, and patients with even high grade injuries can be managed conservatively without embolization as long as they do not demonstrate any vascular blush.

IS THERE LIFE AFTER DAMAGE CONTROL? YES.

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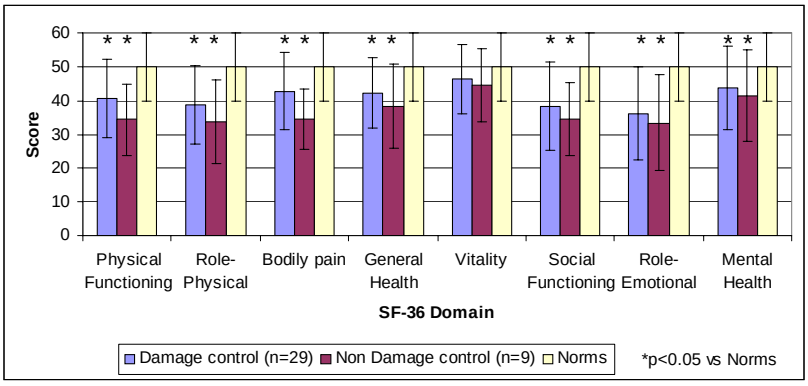
Background: Damage control (DC) has improved survival and is broadly applied in current military theaters. Little is known about health-related quality of life (HRQL) of DC survivors. **Hypothesis**: DC survivors have worse HRQL and psychological well being compared to national norms and severely injured non-DC survivors. **Methods**: We attempted to contact all patients who underwent and survived DC (1997-2004). Patients completed questionnaires composed of the SF-36v2 health survey, the Beck Depression Inventory (BDI), and the Impact of Event Scale (IES), to evaluate HRQL, depressive symptoms, and post-traumatic distress symptoms, respectively. Results were compared with national norms (SF-36v2) and ISS-matched patients who did not undergo DC. **Results**: 29 of 111 DC survivors could be contacted, and all responded. DC patients scored below national norms in 7 of 8 SF-36 domains (Figure). 7 of 29 (24.1%) DC patients had moderate or severe depressive symptoms, and 16 of 29 (55.2%) had moderate or severe distress symptoms. However, between ISS-matched DC and non-DC patients (n=9 in each group), there were no significant differences in SF-36v2, BDI, or IES scores. **Conclusions**: Although DC survivors have decreased HRQL and increased depressive and distress symptoms, DC *per se* does not appear to worsen quality of life when compared to severely injured non-DC patients. Prospective, longitudinal studies of HRQL are necessary to complete our understanding of DC and improve the care of severely injured civilians and soldiers.



INCIDENCE OF EARLY PULMONARY EMBOLISM FOLLOWING INJURY

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Objective: Pulmonary embolism (PE) is a well-recognized potentially fatal complication following trauma. PE is generally thought to occur days after the acute injury. Hypoxia early after injury is often ascribed to other causes. We hypothesized that PE often occurs early after injury and sought to elucidate the timing of PE after trauma.

Methods: The trauma registry was used to identify all patients diagnosed with an acute PE between June 1999 and December 2004. Medical records were reviewed and demographics, injury specific data, length of stay, comorbidities, and mortality were recorded. Time from injury to diagnosis was recorded as was diagnostic modality and treatment.

Results: 35,424 patients were treated in our trauma center over the study period. 96 patients with pulmonary embolism were identified (0.27%). Mean age was 45 years (±18.5) and mean ISS was 23 (±11.4). 83% were male and 91.6% sustained blunt trauma. Mean LOS was 25 (±32.1). Anatomic areas injured included; brain (27%), thorax (43%), abdomen (35%), upper extremity (33%), lower extremity (47%) and spinal cord (18%). The diagnosis was confirmed radiographically in 93 patients; 2 pulmonary embolisms were confirmed at autopsy and one, despite a negative CT scan, was treated based on clinical suspicion. The diagnosis of PE was made by angiogram in 4/96 (4%), V/Q scan in 10/96 (10%), and CT scan in 79/96 (82%). PE was diagnosed on day 1-4 in 36 patients (38%), on day 5-7 in 15 patients (16%), on day 8-14 in 24 patients (25%), and after 14 days in 21 patients (22%). 11% died, but only 2 deaths were attributed to PE.

Conclusion: PE remains relatively common after trauma and occurs in the absence of lower extremity or spinal fractures. While PE is usually thought to occur between days 5 and 7 following injury, our data suggests that as many as 38% of PE's occur early. Clinicians should consider PE in the differential for patients with unexplained hypoxia, even early after injury.

Improving Outcomes through the Performance Improvement Process

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Background: The performance improvement process (PI) in trauma centers and regional trauma systems has traditionally been used to evaluate mortality and provider related complications. We hypothesized that using statistical process control, (SPC), the PI process could improve outcomes as well.

Methods: We applied statistical process control principles to the issue of splenic salvage at our level I trauma center over a three year period. Data collected on the incidence of splenectomy in year one served as the benchmark. A control chart format was employed to display & trend data and intensive education regarding the concept of splenic salvage was employed. An 80% salvage rate was determined from review of the available literature as an optimal target. The current splenic salvage rate was displayed monthly at the PI meetings, compared to the initial rate and the published rate in the literature. Each episode of splenectomy was reviewed using a critical incident review strategy. Only injured adults were included.

Results: There were two periods of analysis. In period 1, 10 of 22 splenic injuries were managed successfully with salvage. The initial splenic salvage rate was 45%. In period 2, after the introduction of SPC, 58 of 63 splenic injuries were managed successfully with salvage. At the end of the three year period, the splenic salvage rate had risen to 92%.

Conclusion: Statistical process control using control chart data display, intensive education coupled with critical incident review of each instance of splenectomy resulted in a dramatic improvement in the overall splenic salvage rate at our trauma center. This adaptation of the PI process resulted in improved care for our patients as a result.

CERVICAL SPINE CLEARANCE IN INJURED CHILDREN UNDER THE AGE OF 3 YEARS: ARE WE OVERDOING IT?

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Cervical spine injuries (CSI) in children are uncommon, but potentially devastating injuries. The optimal method to clear a cervical spine in children less than 3 years of age is undefined. Most infants, who present after sustaining blunt head trauma, undergo a cervical spine computed tomography (CT) scan, the vast majority of which are negative studies.

Methods: The trauma registries of two institutions were reviewed for children less than 3 years of age who sustained blunt trauma over a ten-year period (1995-2005) and had a CT scan of the cervical spine performed. Data regarding the mechanism and type of injury, ISS, presence of head and facial injury, neurologic examination, Glasgow Coma Score (GCS), and outcome were recorded and analyzed.

Results: A total of 935 patients were identified who suffered blunt trauma and had a CT of the spine performed. Death occurred in 43 patients. Of the remaining 892, 11 patients were found to have a CSI (1.2%). Spinal cord injury with permanent disability was noted in 2 cases (0.2%). Halo placement for fixation was performed in 3/11 patients (30%). For every injury identified, 85 CT scans were performed ($27,387 per CSI identified).

	Age (yrs)	ISS	Facial fractures	TBI	Mechanism	GCS
Non CSI	1.5	9.9±9.6	5%	16.5%	Falls (49.2%)	13.2±2.7
CSI	1.4	15.3±12	26%	80%	MVC (100%)	10.7±4.2

Conclusions: CSI in children under the age of 3 is uncommon. The optimal method to assess for CSI in this age group is undefined. CT scans are not effective screening tools, are costly, and likely expose children to unnecessary radiation. Facial fractures, TBI with GCS <10 may, and mechanism of injury may be indications to perform the scan. An AAST-sponsored multi-center study is under way to generate statistical power to delineate the factors that might predict CSI and warrant a C-spine CT scan in this age group.

FIELD HYPOTENSION: A MARKER OF SEVERE INJURY OR CRYING WOLF?

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Introduction: Obtaining an accurate blood pressure (BP) in the field may be difficult. Our purpose was to determine if field hypotension (FH) is a marker of severe injury in patients (pts) arriving at the trauma center with a normal BP (NBP). **Methods:** Demographic, mechanism, injury severity, and disposition data were prospectively collected over 5 years and retrospectively analyzed for all pts ?16 years with documented FH (SBP ? 90mmHg) who arrived with a NBP (FH/NBP). This group was compared to pts who had NBP in the field and on arrival (NBP/NBP). ANOVA and Chi Square were used for statistical analysis. **Results:** 9727 pts were admitted to our rural, Level I trauma center, 3493 had sufficient BP documentation. 2086 were assigned to NBP/NBP and 44 to FH/NBP.

Parameter	NBP / NBP (n=2086)	FH / NBP (n=44)	p-value
Mechanism:	93% blunt	84% blunt	0.02
Mean SBP scene:	140 ± 26 mmHg	70 ± 26 mmHg	< 0.0001
Mean SBP hospital:	142 ± 26 mmHg	125 ± 22 mmHg	< 0.0001
Mean RBC Transfusion:	0.4 ± 1.7 units	2.4 ± 3.5 units	< 0.0001
Mean ISS:	11.1 ± 9.5	22.0 ± 17.9	< 0.0001
Mean GCS	14.0 ± 3.2	10.8 ± 5.6	< 0.0001
Mean RTS:	7.4 ± 1.3	6.5 ± 2.0	< 0.001
ED Disposition: OR:	18 %	34 %	
ICU:	13 %	27 %	< 0.007
Death:	0 %	7 %	
ICU LOS:	7.0 ± 10.3 days	8.6 ± 7.5 days	< 0.0001
Vent Days:	7.8 ± 12.7 days	8.8 ± 9.9 days	< 0.001
Hospital LOS:	7.0 ± 9.7 days	14.0 ± 21.7 days	< 0.0001
Hosp Disposition: Home:	59 %	55 %	< 0.005
Death:	4 %	18 %	

Conclusion: The significance of FH should not be underestimated in pts who arrive with NBP. FH/NBP pts had nearly double the ISS, ED disposition to the OR and ICU, hospital LOS and significantly increased mortality. These findings highlight the importance of proper BP documentation in the field and trauma team readiness in all pts regardless of arrival BP.

Outcome Of OIS High Grade Intrabdominal Solid Organ Injury In The NTDB: Impact of Trauma Center Designation

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Introduction: The NTDB ™ Version 4.0 (NTDB) was queried to assess differences in outcome of splenic, hepatic and renal injuries managed at Level I or II trauma centers as compared to all other hospitals. **Methods:** All NTDB entries with AIS codes for spleen, liver, and kidney were categorized by organ injury scale (OIS) grade. High grade (IV&V) injuries were analyzed for mortality, hospital and ICU LOS, and charges. Operative procedures (ICD-9 procedure codes) related to the specific organ was also assessed. These injuries were then categorized by hospital type, Level I or II trauma centers or all others, and compared for outcome. Analysis was repeated excluding patients with severe traumatic brain injury (AIS?4) or those who died on the day of admission. Statistical analysis was performed using Pearson's chi-square and Student's t-test (p ? 0.05).

Results: Of the 405 hospitals contained in the NTDB, 202 (50%) are Level I or II ACS or State verified trauma centers. 6134, 3874, and 1303 high grade splenic, hepatic and renal injuries were analyzed, respectively.

	Spleen		Liver		Kidney	
Hospital	**L I-II**	**Other**	**L I-II**	**Other**	**L I-II**	**Other**
%of Inj	87%	13%	85%	15%	84%	16%
Mortality	**19.70%***	**23.70%**	40.10%	42.90%	29.70%	33.50%
Op Rx	69.50%	71.20%	**34.10%**	**41.00%***	55.40%	52.90%
LOS (d)	**12.8***	**11.2**	11.4	10.1 ±	13.2	12.5
ICU (d)	6.6	6.2	6.0	5.5 ± 0.4	6.4	6.4
Charges	$75142	$84250	$83503	$70318	$81989	$86138

* p ? 0.05

Outcomes were similar when the severely brain injured patients or patients who died on the day of their admission were excluded from analysis.

Conclusion: The majority of high grade intraabdominal solid organ injury in the NTDB is managed in Level I or II trauma centers. In these centers, the mortality from high grade splenic injury is significantly less but LOS is greater, and hepatic injuries are operated on less frequently as compared to all other hospitals providing data to the NTDB.

NEUROSURGICAL NEEDS IN THE PEDIATRIC TRAUMA POPULATION

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Background: As a result of an ever-changing landscape in medicine, the availability of neurosurgeons to care for pediatric trauma patients continues to decline. The actual need for immediate neurosurgical coverage to care for this patient population is unclear. The purpose of this study was to assess neurosurgical needs in the pediatric trauma population.

Methods: The National Trauma Data Bank (NTDB) was queried for pediatric (age <15) trauma patients for the period Jan 1994 through Dec 2003. Data points included: age, head injuries (ICD-9), interventions and their timing, and outcome.

Results: For the 10 year period, 126,114 pediatric patients were enrolled in the NTDB including 24,976 (19.8%) with a head injury (HI). The mean age was 7.4 years, mean ISS 8, and mean GCS 14. The HI was closed in the majority (94.4%). A craniotomy was needed in 6.2% of all HI patients (1.8% of all trauma patients). Craniotomy was needed in 17.7% of open HI and 5.6% of closed HI. The mean GCS in the craniotomy group was significantly lower 9.5 (vs. 12.3 in non-craniotomy group, p=<0.001). A SDH was present in 13.5% of the HI group (2.7% overall) with craniotomy necessary in 14.8%. An EDH was present in 9.1% of the HI group (1.8% overall) with craniotomy needed in 25.1%. Intracranial pressure monitoring (ICP) was utilized in 5.5% of HI patients (1.4% overall). The median time to ICP placement was 140 minutes, the median time to craniotomy 163 minutes. Of the craniotomies, 12.8% occurred within an hour of admission. Survival was 81.3% when craniotomy occurred within 1 hour, 88.7% when performed >1 hour (p=0.09).

Conclusions: With the dearth of pediatric neurosurgical specialists, and with the relatively rare need for immediate neurosurgical intervention in the pediatric trauma population, guidelines for neurosurgical consultation should be thoughtfully crafted. The vast majority of pediatric HI patients can be appropriately managed without the immediate availability of a pediatric neurosurgeon.

DOES INCREASED EMS PREHOSPITAL TIME AFFECT PATIENT MORTALITY IN RURAL MOTOR VEHICLE CRASHES? : A STATEWIDE ANALYSIS

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OBJECTIVE: Fatality rates from rural vehicular trauma are almost double those found in urban settings. It has been suggested that increased prehospital time is a factor that adversely affects fatality rates in rural vehicular trauma. By linking and analyzing Alabama's statewide pre-hospital data, Emergency Medical Services (EMS) prehospital time was assessed for rural and urban vehicular crashes.

METHODS: An imputational methodology permitted linkage of data from police motor vehicle crash and EMS records. Motor vehicle crashes (MVCs) were defined as rural or urban by crash location utilizing the United States Census Bureau criteria. Prehospital data were analyzed to determine EMS response time, scene time and transport time in rural and urban settings.

RESULTS: Over a 2-year period from January 2001 through December 2002, data were collected from Alabama EMS Patient Care Reports (PCR's) and police crash reports. 45,763 police crash reports were linked to EMS PCR's. Of these, 34,341 (75%) and 11,422 (25%) were injured in rural and urban settings respectively. 611 (1.78%) mortalities occurred in rural settings and 103 (.90%) occurred in urban settings ($p<0.0001$).

Response Times for all Mortalities (min)	Rural	Urban	p-value
Mean EMS Response Time	10.67	6.50	< 0.0001
Mean EMS Scene Time (excludes DOS & extrication)	18.87	10.83	< 0.0001
Mean EMS Transport Time (excludes DOS)	12.45	7.43	< 0.0001
Overall Mean EMS Prehospital Time	42.0	24.8	< 0.0001

Mean EMS response time for rural MVCs with survivors was 8.54 minutes versus 10.67 minutes with mortalities ($p < 0.0001$). Mean EMS scene time for rural MVCs with survivors was 14.81 minutes versus 18.87 minutes with mortalities (dead on scene (DOS) and extrication patients excluded) ($p = 0.0014$).

CONCLUSION: Based upon this statewide data analysis of MVCs, increased EMS prehospital time is associated with higher mortality rates in rural settings.

SO RETRIEVABLE: IMPACT OF PROTOCOL ON RETRIEVAL OF TEMPORARY VENA CAVAL FILTERS IN HIGH RISK TRAUMA PATIENTS

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Introduction: Despite the widespread use of retrievable filters (RF) in trauma patients, actual "retrieval" rates remain low. We hypothesized that implementation of a retrieval protocol would significantly increase retrieval rates and decrease indwelling filter times.
Method: Retrospective review of RF placed prior to (Group 1: 1/1/00 – 12/31/05) and after (Group 2: 2/1/05 – 12/31/05) institution of a formal retrieval protocol. Variables reviewed included demographics, ISS, Mechanism of Injury, retrieval characteristics, PE and complications related to filter placement and retrieval. All filters were placed and retrieved in the interventional radiology suite. Indications for filter placement were based on injury complex, weight bearing status and contraindications to chemical or mechanical prophylaxis. Data was analyzed using t-test, chi-square and Wilcoxin rank-sum tests.
Results:

	Overall	Group 1	Group 2	p-value
N	65	38	27	
Mean ISS	31	34	27	0.067
Retrievable	43	24	19	0.545
Retrieved	32 (68%)	14 (52%)	18 (90%)	0.006
Median days Placement to Retrieval	66	73	49	0.025

Complications related to filter placement (tilt, arterial puncture) and retrieval (PE) occurred in 3 and 7% of patients, respectively. Filters were successfully retrieved as far out as 739 days. No PE occurred following filter retrieval.
Conclusions: The implementation of a retrieval protocol significantly increased retrieval rates and decreased indwelling filter times, thereby potentially minimizing complications related with their use.

ETHNIC DISPARITIES EXIST IN TRAUMA CARE

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Objective: An estimated 5.3 million men, women, and children in the U.S. live with permanent disability related to traumatic brain injury (TBI). Access to rehabilitation after TBI is critical in minimizing these disabilities. Ethnic disparities in health care have been documented in other diseases, but have not yet been studied in trauma care. We hypothesized that access to post-TBI rehabilitation is influenced by race/ethnicity.

Methods: Retrospective analysis of NTDB patients discharged alive with severe blunt TBI (Head AIS 3-5, n= 58,729) was performed. Placement into rehab after discharge was studied in three groups: Non-Hispanic Caucasian (NHC 77%), African American (AA 14%), Hispanic (HIS 9%). The two minority groups were compared to NHC patients, using logistic regression to control for differences in age, gender, overall injury severity (ISS), TBI severity (head AIS and GCS), associated injuries, and insurance status.

Results: The three groups were similar in ISS, TBI severity, and associated injuries. AA and HIS patients were significantly less likely to be placed in rehab, even after stratification by insurance type (table). After adjusting for differences in potential confounders and insurance status, minority patients were 15% less likely to be placed in rehab (OR 0.85, 95% C.I. 0.8 to 0.9, $p < .0001$). These differences were more prominent in HIS patients.

Insurance type	NHC	AA	HIS
All patients	23%	20%*	16%*
Uninsured	17%	13%*	12%*
Private	25%	24%	22%*
Government	24%	21%*	17%*
Worker's Comp	30%	27%	23%*
Other insurance	23%	21%	11%*
* $p < .05$ compared to NHC			

Conclusion: Ethnic minority patients are less likely to be referred to rehab than non-minority patients, even after accounting for insurance status, suggesting existence of systematic inequities in access. Such inequities may have a disproportionate impact on long-term functional outcomes of African American and Hispanic TBI patients, and suggest the need for an in-depth analysis of this disparity at a health policy level.

ED LENGTH OF STAY: A MAJOR RISK FACTOR FOR PNEUMONIA IN INTUBATED BLUNT TRAUMA PATIENTS

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Background: Pneumonia occurs commonly in intubated patients and is morbid and occasionally mortal. Pneumonia prevention strategies have been successful in the ICU and are favorably regarded, cost effective, and efficacious. Trauma patients are often intubated emergently in the prehospital or ED setting. Nationwide, hospital overcrowding has resulted in prolonged ED length of stay (LOS) for intubated patients. We sought to study the effect of prolonged ED LOS and its association with increased rates of pneumonia. **Methods:** This was a 2 year retrospective case control study of all blunt trauma patients presenting to an urban level I trauma center who were emergently intubated and developed pneumonia. The trauma registry was queried for demographic information and clinical variables. All patients who were intubated prehospital or in the ED and developed pneumonia were identified as cases. A group of matched controls with equivalent age, ISS, AIS chest, and AIS head who did not develop pneumonia were identified. A comparison of ED LOS between the two groups was assessed using conditional logistic regression. **Results:** Of 736 patients emergently intubated, 509 (69%) had sustained blunt trauma. Of these, 39 (7.66%) developed pneumonia and were entered into the analysis. Average age, ISS, AIS Chest, and AIS Head for the patients entered into the analysis (39 cases, 143 controls) were 41.93 (+/-19.72), 33.95 (+/- 13.37), 2.93 (+/-0.96), and 4.53 (+/-0.86). Average ED LOS for all patients in the analysis was 240.75 minutes. ED LOS was significantly associated with pneumonia ($p < 0.05$). Each hour increased the risk of developing pneumonia by approximately 20%. Pneumonia was significantly associated with longer ICU stays (5 vs. 17 days ($p<0.01$)), and longer hospital stays (12 vs. 27 days ($p<0.01$)). **Conclusions:** In blunt trauma patients who are emergently intubated, increased ED LOS is an independent risk factor for pneumonia. VAP interventions, successful in the ICU, should be implemented early in the hospital course, and efforts should be made to minimize hospital overcrowding and ED LOS.

THE ROLE OF THE DEDICATED TRAUMA TEAM PHARMACIST: A PILOT STUDY TO ASSESS PATIENT SAFETY BENEFITS.

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Introduction: The initial resuscitation of an acutely injured patient is often a complex, team driven effort. With the increasing national emphasis on patient safety, we have developed a model which incorporates an ATLS trained, emergency department clinical pharmacist (EDCP) in our initial trauma response. The purpose of this study was to assess whether or not the addition of a dedicated pharmacist to the trauma team improved the process of medication management in our patient population. **Methods:** A retrospective chart review was performed at our state-designated regional trauma center between July 1, 2004 and December 1, 2004. Trauma team activations were divided into two groups, one in which the EDCP was present and one in which the EDCP was not. Factors related to medication management were captured and analyzed, including the time to first administration of a medication by class, evidence of proper documentation and the occurrence of adverse events. **Results:** 204 charts from trauma team activations met inclusion criteria, with an EDCP present at 51 resuscitations. Both groups were similar in terms of patient demographics and mechanism of injury. Time to administration of first medication is summarized below.

	EDCP present (n=51)		EDCP not present (n=153)	
Time to first medication (min)	Median (min)	Mean (min)	Median (min)	Mean (min)
Rapid sequence intubation*	4	10.4	10	14.2
Analgesia	12	23.0	20	43.6
Sedative	12	22.6	28	49.4
Paralytic[+]	13	26.7	25	37.0
Antibiotic	11	14.1	20	65.1

* Does not include out-of-hospital intubation. [+]Does not include medication for initial intubation.

Presence of an EDCP improved time to medication administration overall by an average of 10 minutes. Documentation errors were identified in 17 records from the control group and 1 record when an EDCP was present. Adverse drug effects were noted in 9 patients in the control group and no patients when an EDCP was present. **Conclusion:** This pilot study suggests that inclusion of a dedicated pharmacist in the initial trauma team response reduced medication errors and decreased time to medication delivery during the initial resuscitation period. The potential patient safety benefits of improved medication management in this patient population warrants further examination of this concept.

METHODS OF TEMPORARY ABDOMINAL CLOSURE: IS THERE A DIFFERENCE IN OUTCOMES?

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Purpose: Damage control laparotomy with temporary abdominal closure (TAC) has become more common. Methods of TAC include the Bogotá bag, parachute silk and the Vacuum-assisted closure (ABD-VAC). We sought to determine which TAC method provides the most rapid definitive fascial closure, the fewest number of complications and operating room procedures (#OR).

Methods: A retrospective review was performed using the trauma registry to identify patients undergoing exploratory laparotomy from 01/01/2001 to 06/30/2005. Inclusion criteria were TAC and survival to definitive abdominal closure. Data collected included age, ISS, ABD_AIS, base deficit (BD), number of OR procedures, primary fascial closure rate and complications. Complications were defined as infection, dehiscence, and planned hernia. Statistical analysis was performed with X^2 and t-test with significance attributed to $p<0.05$. Data are expressed as mean $\pm$SD.

Results: During the study period 122 patients had one of the study types of TAC. 59 patients met inclusion criteria and were then stratified according to method of TAC. There were no differences between groups in age, ISS, ABD_AIS, or BD.

TAC	N	Primary closure	#OR	Days to closure	Complications
ABD-VAC	22	82%	3±0.3	7±1	9%±0.1
Parachute	26	50%*	5±0.7 *	30±11*	58%±0.2*
Bogotá Bag	11	66%*	2±0.5	7±1	73%±0.2*

*p <0.05 compared to ABD-VAC

Conclusion: The ABD-VAC method of TAC is superior to other methods described. It had a significantly higher rate of closure, less OR utilization, and the lowest complication rate.

MECHANISM OF INJURY IN PEDIATRIC TRAUMA PATIENTS IS AN UNRELIABLE PREDICTOR OF INJURY SEVERITY

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Objective: Pre-hospital triage identifies major trauma for appropriate utilization of resources. Current American College of Surgeons Committee on Trauma(ACSCOT) guidelines use anatomic and physiologic parameters and mechanism of injury for triage. We sought to determine whether these guidelines predict injury severity in pediatric trauma patients and if triage according to mechanism of injury alone justifies activation of a trauma team. **Methods:** Charts of all children <18 years admitted to our Level I trauma center (2001-2005) were assessed for demographic data, mechanism of injury (MECH), physiologic parameters(PHY) as defined by the ACSCOT field triage decision scheme, and heart rate according to Pediatric Advanced Life Saving(PALS) guidelines. Outcome was measured by an Injury Severity Score(ISS) >15. Univariate and multivariate logistic regression analysis was performed to determine if these variables resulted in higher ISS. **Results:** There were 1,566 patients (60% male, 98% survival) who met ACSCOT field triage criteria. Triage based on MECH alone did not increase the odds of a severe injury (odds ratio:0.65, $p<0.006$). Triage based on MECH+PHY increased the odds of a more severe injury by 12.26 ($p<0.001$.) Univariately, MECH+PHY as triage variables increased the odds of a higher ISS by 12.26 compared to mechanism alone ($p<.001$). Multivariate analysis, including presence of head injury and additional physiologic parameters, revealed that MECH+PHY increased the odds of severity two-fold ($p=0.013$) compared to MECH alone (odds ratio:0.96,$p=0.826$). Of the PHY, GCS showed the strongest association with injury severity (odds ratio of 8.8, $p<0.05$). Heart rate by age (PALS) identified 40% of the injured population compared to 12% identified by PHY. **Conclusions:** Mechanism of injury alone is an unreliable indicator of injury severity in the pediatric population. Together, physiologic parameters and injury mechanism are better indicators for pre-hospital triage. Heart rate may be a better prehospital indicator in identifying pediatric patients in need of transport to a Level I trauma center.

LEGISLATIVE FUNDING OF UNCOMPENSATED TRAUMA CARE INCREASES PARTICIPATION IN THE TRAUMA SYSTEM

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Introduction: Funding of trauma systems (TS) is vital. Without TS funding, public health and national security are both at risk. We detail a single state's efforts to achieve funding of a sustainable trauma system.

Methods: Using state health department, auditor and legislative records we assess the successes, failures and TS expansion related to a single state's legislative initiatives to fund its trauma system.

Results: A statewide TS was initiated in 1989. This system consists of 22 regions governed through 22 separate regional advisory councils (RAC), each of which is a 501(c)3 non-profit corporation. The system was unfunded until 1998 when the state legislature allocated a $4 million (M) surplus of state 911 revenues to fund both the RACs and EMS. The 911 dollars were eventually decreased and replaced with state tobacco settlement dollars. These funds provided for the RACs administrative infrastructure, thus bolstering the TS. They did not, however, cover the estimated $200 M in uncompensated trauma care provided annually by TS hospitals. In 2003, the state instituted a Driver Responsibility Program (DRP) that consists of a driver points/fee system for driving infractions including driving while intoxicated (DWI). DRP fund disbursements to hospitals by year were as follows: $18.2 M in 2004, $45.9 M in 2005, and $87.4 M in 2006 (projected). Revenue generated by the DRP has been less than expected due to problems in tracking, assessing, billing and collecting fees. These problems have resulted in a loss of $25 M in revenue in 2004-2005. In 1998 there were 132 designated trauma centers: 8 Level I, 5 Level II, 11 Level III, 108 Level IV. In 2006 there are 13 Level I, 10 Level II, 42 Level III , 181 Level IV, for a total of 246 trauma centers (86% increase).

Conclusions: State funding of both unreimbursed care and its trauma system is feasible. A driver responsibility program is a promising mechanism for achieving this funding. State funding is associated with increasing hospital participation in the trauma system.

STAY AND PLAY INTERVENTIONS ON UNSTABLE PENETRATING TRAUMA PATIENTS: IS THERE AN ASSOCIATION WITH INCREASED SURVIVAL?

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Introduction: The role of pre-hospital healthcare personnel in the management of acutely injured patients is rapidly evolving. We hypothesized that expansion of pre-hospital procedures performed by emergency personnel on unstable penetrating trauma patients requiring emergency department (ED) thoracotomy improves survival.

Methods: A retrospective chart review on 89 consecutive penetrating trauma patients at a Level I trauma center (2004-05) who underwent ED thoracotomy was performed. Patients were divided into two groups by mode of transportation and compared on the basis of injury mechanism, presence of multiple injuries or cardiac injury, presence of signs of life (SOL), number of pre-hospital procedures, and survival.

Results: Forty-eight patients arrived by police or private vehicle while 41 were brought by EMS. Groups were similar with respect to demographics. Despite a mean of 2.1 pre-hospital procedures per patient, the EMS group demonstrated no increase in survival.

	Police/Private (n=48)	EMS (n=41)	*p* value
Stab Wound	2% (1/48)	10% (4/41)	0.176†
Gun Shot Wound	98% (47/48)	90% (37/41)	0.176†
Multiple Injuries	67% (32/48)	66% (27/41)	0.885§
Cardiac Injuries	38% (18/48)	37% (15/41)	0.896§
SOL in Field	75% (36/48)	85% (39/41)	0.021§
SOL in ED	69% (33/48)	76% (31/41)	0.630§
# Procedures (per pt)	0	2.1	NA
Hospital Survival	10% (5/48)	2% (1/41)	0.212†
†Fisher's Exact Test, §Chi Square			

Conclusions: In the EMS group, pre-hospital procedures did not result in a significant increase in SOL on arrival to the ED despite more often having SOL in the field. A trend toward decreased survival in the EMS group was noted, and may be due to a delay in arrival to our urban trauma center. Thus, the extent of interventions in the field by

AN UPDATE OF TRAUMA SURGEON COMPENSATION: SURVEYOF AAST AND EAST

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There continue to be few data on compensation for trauma surgeons. Limited survey data exist but are one time estimates and may no longer be reliable. The purpose of this study was to provide updated data on compensation, benefits and productivity by survey of members of the American Association for the Surgery of Trauma (AAST) and the Eastern Association for the Surgery of Trauma (EAST). **Methods**: A web based survey was developed and validated with a small group of trauma surgeons. Anonymous participation was solicited by e-mail and printed letter sent to all members of the AAST and EAST. Responses were maintained in a secure database and analyzed by a blinded individual. Data on demographics, educational background, hospital and practice characteristics, compensation type and amount, benefits and charges submitted were collected. **Results:** 161 surgeons responded to the survey between 11/1/04 and 3/31/05 but only 137 surveys were suitable for analysis. 61% specified organizational membership: 22% belonged to AAST, 29% to EAST and 49% to both. 87.2% were male, mean age was 48 years (range: 34-71). Primary employers were: 50.4% medical school, 34.6% hospital, 10.5% private practice, 2.3% military. Mean total compensation (n=128) was $278,944 (median $255,000) and varied by years in practice (table). 94.4% received a base salary and 50% received a bonus. Respondents averaged 21 days of vacation. The majority had liability insurance coverage provided at no cost and defined contribution healthcare and retirement plans. **Conclusion:** Mean compensation for trauma surgeons in this limited sample was higher than previously reported. Compensation frequently includes bonuses and other payments in addition to base salary. Comprehensive, reliable data remain elusive given the relatively low response rate in this study and the incomplete responses encountered. A well organized, concerted effort is needed to collect, analyze and distribute comprehensive annual data on trauma surgeon compensation.

In practice	Mean Comp
≤ 10 years	$240,000
11-20 years	$265,000
21-30	$360,000
31-40	$290,000

Mobile Digital Subtraction Angiography (DSA) for Acute Vascular Intervention for Trauma (AVIT) in the Emergency Room (ER).

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Introduction: Acute Vascular Intervention for Trauma (AVIT) is a new concept in acute haemostatic strategy for trauma patients combining imaging and endovascular catheter techniques. AVIT is one tactical option in the modern comprehensive strategy of acute trauma acre. Medical resources and ER facilities are required for AVIT. This study is the first report on mobile Digital Subtraction Angiography (DSA) as a tool for AVIT in the ER of a tertiary emergency center. **Methods**: From January 2001 to July 2002, an angiography suite (located on the 3rd floor) was used for AVIT (group A). From August 2002, after installing ER (located on the 1st floor next to trauma ICU) as radiology regulated area and possessing a mobile DSA device, AVIT was performed in the ER (group B). Injury Severity Score (ISS), Shock Index, intervals from Emergency Medical Service (EMS) call to hospital arrival and from hospital arrival to AVIT, and mortality were analyzed. **Results**: There was no adverse effect of AVIT in ether groups (A: 14; B: 41). Between the two groups, there was no difference in age (37±18 vs. 43±21 y.o.), gender (M/F; 5/9 vs. 27/14), ISS (29±9.4 vs. 23±14), interval from EMS call to hospital arrival (32±8.8 vs. 38±5.3min). The interval from hospital arrival to start of endovascular procedures in the group B was significantly shorter than that of group A (191±287 vs. 112±49min, $p<0.05$). A significant difference in mortality was recognized (A: 6/14=0.4 vs. B: 4/41=0.1, $p<0.05$). Focusing on those who were required immediate haemostatic technique because of severe shock on arrival and being barely normotensive despite initial aggressive fluid resuscitation in the ER, the interval from hospital arrival to completion of endovascular haemostatic procedures in those patients in group A (n=10) was significantly longer interval than that of group B (n=3, 224±11 vs. 166±41min, $p<0.05$). **Conclusion**: AVIT was performed by members of our resuscitation team for severe trauma. In addition, by using the mobile DSA equipped in our ER, no resuscitation procedure was interrupted to prepare or perform an endovascular intervention. A mobile DSA is important for acute trauma care with AVIT.

ELDERLY HIP FRACTURE PATIENTS ADMITTED TO THE TRAUMA SERVICE: DOES IT IMPACT PATIENT OUTCOME?

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Introduction: Our hospital has a policy of admitting all hip fx patients to the trauma/critical care service. This policy was instituted following a quality assurance project that revealed an unexpected high in-house mortality of 20% among our elderly hip fx patients admitted directly to the orthopedic service/floor. As part of this new policy all patients over 65 are admitted to the trauma/critical care service where they are placed in either the Surgical Intensive Care Unit (SICU) or the Stepdown Unit (SDU). The goal of this study is to see if admitting hip fx's to the trauma/critical service had a positive impact on in-hospital mortality in these patients.

Methods: The trauma and operating room registries were used to identify all patients who presented with a hip fx during the 5 year period from Jan. 1, 2000 to Dec. 31, 2004. Data was then retrieved from patient charts. All patients less than 65 or with incomplete charts were excluded. Outcome variables included length of stay (LOS), time from admission to operating room, in-hospital mortality and in-hospital complication rate.

Results: There were 150 patients 65 and over with complete charts, of which, 43 were male and 107, female. The mean age was 80.7 years and the median ISS was 10 (range, 9-34). Falls were the primary mechanism of injury (91%). The mean LOS was 9.3 days and mean time from admission to OR was 1.7 days. Overall in-hospital mortality was 3.3% . There was a 44% in-house complication rate.

Conclusion: Our overall mortality of 3.3% is significantly lower than our previous mortality and is one of the lowest reported in the English literature for hip fx. We attribute these results to at least two factors: 1) the trauma/critical care service is accustomed to managing the critically ill or severely injured geriatric patient; 2) admission to the SICU or SDU affords the benefit of critical care nursing and monitoring. Our data strongly suggest the trauma service can play a beneficial role in managing the elderly hip fx patient.

DURATION AND SAFETY OF COMPUTED TOMOGRAPHY IN SEVERELY INJURED BLUNT TRAUMA PATIENTS

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Speed and detail have made Computed Tomography (CT) a pivotal diagnostic tool in the evaluation of trauma patients, yet it is employed at a potentially hazardous time. The purpose of this study is to quantify the time required for CT scans and the attendant risks to hemodynamic stability in the seriously injured, blunt trauma patient. **Methods:** Charts of patients requiring full trauma activation in 2004 were reviewed. Pregnancy, age <18, and penetrating injuries were excluded. Data collected included vital signs (VS) during resuscitation, VS on exit from trauma bay (TB), VS during CT scan and total time between TB exit and ICU/OR arrival. Hemodynamic (HD) instability was defined as SBP <90mm Hg or HR >120 bpm. **Results:** 269 patients, mean age 41, 77% male, mean ISS 23, and mortality 21% were included. 248 patients (92%) had CT scans and 212 had VS recorded in CT. Group 1 was always stable in TB. Group 2 was unstable in TB but stabilized prior to leaving TB. Group 3 was always unstable in TB (Table). Mean TB and CT times were 38 and 41 minutes respectively. The mean times needed to complete single (31-36 minutes) vs. multiple (35-46 minutes) body area CT scans were similar. Patients with a Stability Index (lowest SBP/highest HR) of <1 in TB were more likely to destabilize while in CT ($p<0.0001$). **Conclusions:** In this study, more time was spent in CT than in the TB. There was a marginal increase in time required for multiple body area CT scans compared to single body area CT scans. HD status in the TB helps identify risk of HD instability in CT scan. Unstable patients should not be taken to CT scan. Given the risk of instability in CT scan, stable patients and especially those who become stable with resuscitation should only go to CT if appropriate personnel can continue full monitoring and resuscitation there. The Stability Index (SI) proved useful in predicting risk of instability in CT scan but requires further validation.

Group	Unstable in CT	CT time	ISS	Died
1	4%	42 min	21	16%
2	33%	43 min	24	16%
3	82%	39 min	30	29%

PREHOSPITAL PERSONNEL CAN EFFECTIVELY IDENTIFY TRAUMA PATIENTS FOR HELICOPTER TRANSPORT WITHOUT BASE STATION APPROVAL

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Background: Effective utilization of prehospital helicopter transport requires both accurate assessment of patients and effective communication. The rural county adjacent to our developed trauma system has used standardized triage criteria to identify patients for direct transport to our trauma centers (TC). We hypothesized these criteria accurately identify major trauma victims (MTV) and further that communication could be simplified to expedite transport. **Methods:** Prehospital personnel use a MAP (Mechanism, Anatomy, Physiology) scoring system to triage trauma patients. Patients with $\geq$ 2 'hits' are defined as MTV. In 2004, the triage policy was changed so that MTV would be transported directly to a TC without base hospital consultation (previously required). The EMS Medical Director reviewed cases transported to the TC to determine the appropriateness of triage decisions (over- and under-triage using COT definitions). Data were compared before and after this policy change. **Results:** For 2004, we evaluated 161 (13.4/ month) air transports to TC and compared them to 468 (8.4/month) in the prior 56 months (* $p < 0.01$).

	2004	**Prior 56 months**
MTV transported	111 (68.9%)	369 (78.8%)
Over-triage	46 (28.6%)	80 (17.1%)
Mis-triaged	4 (2.5%)	18 (4.1%)

Upon review, 14/18 (78%) patients identified in field as minor trauma but transported to TC in 2004 were actually MTV compared to 25/44 (57%) previously. **Conclusions:** Prehospital personnel can accurately use a trauma triage tool, as well as there clinical judgment, to identify MTV. Eliminating base station contact, a potential for introducing communication error, did increase over-triage but still well within accepted limits. However in the later period, a greater proportion of minor trauma patients taken to trauma centers did indeed have major injuries. With proper training, prehospital personnel can effectively use a triage tool to identify patients for transport to TC without base station approval.

TRAUMA TEAM ACTIVATION AND THE IMPACT ON MORTALITY

Robert A. Cherry MD*, , Tonya S. King PhD, , Daniel E. Carney MD, , D. Patrick Bryant MD, , Robert N. Cooney MD

Introduction: Trauma centers often use common clinical criteria to determine the extent of trauma team activation and appropriate resource utilization in the ED. We examined whether our trauma team activation (TTA) criteria stratified patients appropriately by injury severity and resulted in better outcomes. **Methods:** The trauma registry at our Level 1 trauma center was retrospectively reviewed in 2004 for full (Level 1 or L1), partial (Level 2 or L2), and limited (Level 3) adult blunt TTA. Data was collected on age, ISS, hospital LOS, SBP, HR, RR, GCS, intubation status. Penetrating injuries, traumatic arrests, and interfacility transfers were excluded. Median (25^{th}-75^{th} %). Hazard ratios (HR). Kruskal-Wallis, χ-square and survival analyses. *Overall p<.05 and ** pair wise p<.05 vs. L1. **Results:** 494 patients met criteria out of 1,969 admissions. There was a statistically significant difference in survival between L1 and L2 at 38 days, but not for > 38 days (p=0.739). When combined in a multivariate model to evaluate multiple predictors simultaneously, SBP<90 and GCS< 8 appear to be the strongest predictors of mortality (RR and intubation were not significant in the presence of SBP and GCS). **Conclusions:** GCS<8 and SBP<90 are predictive of mortality and should be used as criteria for full TTA in adult blunt trauma. TTA criteria also stratified patients appropriately by ISS. Unfortunately, full TTA in adult blunt trauma did not impact late (6-week) mortality.

	Level 1 N=174	Level 2 N=287	Level 3 N=33
Age	41 (25-55)	43 (28-58)	42 (28-57)
ISS*	22 (14-34)	14 (9-21)**	10 (5-17)*
Hosp LOS*	7 (3-18)	4 (2-7)**	3 (2-5)*
Mortality(2wks)*	17%	3%**	0%
Mortality(4wks)*	21%	6%**	0%
Mortality(6wks)	26%	25%	3%

	HR	95% CI
SBP<90	9.4	4.2, 21.2
RR>29,<10	17.8	4.8, 66.0
Intubation	4.5	2.3, 8.9
GCS<8	9.7	4.8, 19.9

SIMULATION EDUCATION FOR THE MANAGEMENT OF BLUNT HEAD TRAUMA

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Purpose: During 2005 a trauma simulation course was offered at our Level I trauma center. This course addressed appropriate management of a simulated patient with blunt head trauma (BHT) upon arrival to the trauma center. Self-efficacy (SE) and knowledge before and after the educational session was assessed. The objectives were to answer the following: 1) Is SE for the management of BHT increased for participants who attend a BHT simulation education session, and 2) Is knowledge regarding the management of BHT increased for participants who attend a BHT simulation education session?

Methods: This was a single group pre-test, post-test design conducted during 2005 at our simulation education center. Forty trauma team members (Fellows, Residents, PA's, PA Students and an APRN) participated. Pre-tests to assess SE and knowledge were completed. SE was assessed with a 5-item, 5-point response format with 1 indicating "very little confidence" and 5 indicating "quite a lot of confidence". Knowledge was assessed with a 10-item multiple-choice test. The students then simulated the management of the patient. After this, a debriefing session and PowerPoint presentation of the anatomy, pathophysiology of BHT, and an overview of common types of BHT and their management were given. After the presentation, the students completed the SE instrument and multiple-choice knowledge test. Paired *t* tests were used to compare the pre and post SE means and the pre and post knowledge means. A *p* of less than 0.05 was considered significant.

Results: Statistically significant increases were noted from pre to post education for SE and knowledge.

	Pre-test Mean ± SD	Post-test Mean ± SD	*p* value
Self-efficacy	2.9 ± 0.83	3.7 ± 0.80	< 0.05
Knowledge	6.1 ± 1.72	7.0 ± 1.32	< 0.05

Conclusions: SE and knowledge increased for participants in the structured, standardized simulation session for the management of BHT. We plan to expand simulation education to the management of other injuries and continue to evaluate educational outcomes.

THE CRIBARI MATRIX: A KEY COMPONENT FOR TRAUMA PERFORMANCE IMPROVEMENT

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Background: Analysis of over and undertriage is an integral part of trauma performance improvement. The purpose of this study is to present a matrix method for evaluating potential over and undertriage as part of performance improvement, and to apply the matrix to trauma registry data from an American College of Surgeons verified level II center.

Methods: The matrix method retrospectively assigns injury severity with major injury defined as Injury Severity Score (ISS) > 15. Potential overtriage was defined as the proportion of patients with minor injuries (ISS < 15) who had the highest level of trauma team activated divided by total number of highest level trauma team activations (A/A+B). Potential undertriaged cases were identified as the proportion of patients with major injury (ISS > 15) divided by total number of limited trauma team activation or with no team activation (D/C+D). The matrix was applied to our trauma registry data from 1996 - 2005.

Trauma Team Activation	ISS ? 15 (Minor)	ISS > 15 (Major)	Total
Full	A	B	A+B
Limited & No Team	C	D	C + D
Total	A + C	B + D	A + B + C + D

Percent mortality was calculated for under and overtriage groups. A z-test statistic was used to compare proportional differences in mortality between under and overtriage.

Results: 12,766 trauma cases were evaluated over a ten year period (1996-2005); mortality among this group was 2.22%. Percent mortality among identified over and undertriaged cases was 0.9% and 6.8%, respectively. Proportional differences in mortality between over and overtriage cases were statistically significantly different ($p < 0.05$).

Conclusion: This performance improvement matrix is a useful tool for evaluating over and undertriage. The results of this study emphasize the need to critically review undertriage cases so that programmatic changes can be implemented in hopes to further reduce morbidity and mortality. Likewise, the evaluation of overtriage is important for minimizing the over utilization of resources and substantiating trauma team activation reimbursement.

COGNITIVE IMPAIRMENT IN MULTIPLE TRAUMA PATIENTS

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COGNITIVE IMPAIRMENT IN MULTIPLE TRAUMA PATIENTS

PURPOSE: The purpose of this study was to assess the incidence of long-term cognitive deficits in severely injured multiple trauma patients. In addition, we hoped to identify potential predictors of long-term cognitive deficits in terms of patient demographics, injury and treatment.

METHODS: Following IRB approval, a query of the trauma registry (TRACS) identified 100 adult patients with Injury Severity Score (ISS) greater than 25 and no closed head injury as determined by negative CT scan at the time of admission. There were 58 patients that were able to be contacted, informed consent obtained and underwent chart review of demographics, injury and treatment. The patients were also given an extensive battery of neuropsychological testing to assess for long-term cognitive deficits, post traumatic stress disorder (PTSD) and depression. The patient's mean age was 45 +/- 14 years (range 20-72). Education level was a mean of 12.7 years +/- 2.3 (6-18). Thirty-nine of the patients were male and 19 patients were female, 51 patients were white, 5 black and 1 Hispanic. Injury severity score mean was 33 +/- 6.8 (26-51).

RESULTS: The patients had no significant incidence of pre-existing dementia. of the patients had returned to their previous work, but 42% felt they were not as effective at their pre-injury job. SF-36 scores were significantly decreased in all domains except social function compared to general population norms. Fifty-seven percent of the patients were noted to have significant cognitive impairment compared to general population norms; 28% had moderate to severe depression scores and 38% tested positive for PTSD. Long-term cognitive impairment and post traumatic stress disorder was not predicted by age, sex, race, injury severity score, blood loss, ventilatory days or intramedullary nailing of long-bone fracture. Eighty-one percent of the patients with skull fracture or concussion had long-term cognitive impairment. A skull fracture or concussion was significantly correlated P = 0.0064 (Fisher's exact test) with long-term cognitive impairment.

CONCLUSION: This cohort of patients had no evidence of closed head injury at the time of admission, but had a large incidence of long-term cognitive impairment, post traumatic stress disorder, and depression and may need appropriate referral to rehabilitative services.

Analiysis of Quality of Life in Mild Head trauma Patients who had been submitted a CT scan and S100B Protein measurement during initial emergency admission room 15 months before.

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Introduction: S100B Protein has been suggested as a marker for the need of head CT scan after mild head trauma (MHT, GCS 13-15). We performed head CT scan and S100B measurement in 50 patients with symptomatic MHT showing a sensitivity of 100% and a specificity of 20% in predicting altered CT scan(1). After 15 months of trauma, we evaluated these patients' Quality of Life(QOL) using SF 36 Questionnaire (SF 36) and correlating that score with CT scan and S100B Protein findings. **Methods:** Forty patients of the initial 50 symptomatic MHT patients admitted at a large trauma center were interviewed using the SF 36 Form after 15 months of head trauma. During the admission, all patients had a head CT scan performed and S100B Protein measured within initial two hours from trauma. Six patients in the sample showed a positive CT although no posttraumatic relevant lesions were detected. S100B protein was considered positive for [ ]>0.1µg/l (41 patients). As control group, 44 co-inhabitants of similar age and sex, with no past history of head trauma, were interviewed and answered the same questionnaire. We used Cronbach's alpha to test the questionnaire confiability, T-test for paired observations to compare patients with their control. We employed linear regression with repeated measures and ANOVA. A *p* level of <0,05 was considered significant. **Results:** Patients sustaining MHT showed significantly worse QOL (SF 36 score) than their control. There is 8 Domains in SF 36 . When functional ability, vitality and mental health are considered, there is difference with *p* level< 0,001. When pain, health general state and social aspect are considered, there is difference with *p* level< 0,01 and there is no difference when physical and emotional aspects are considered. We found no correlation between Quality of life and S100B Protein level (*p*= 0.605) or positive findings in head CT scan (*p*=0,457).**Conclusion:** Patients sustaining MHT present lower QOL (scored by SF 36 Questionnaire) when compared with controls; however, there is no correlation between QOL and S100B level measurement or positive CT scan performed 15 moths earlier.

ANGIOGRAPHY FOR BLUNT SPLENIC TRAUMA DOES NOT IMPROVE THE SUCCESS RATE OF NONOPERATIVE MANAGEMENT

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Angiography (angio) is reported to increase splenic salvage as an adjunct to nonoperative management (nonop). Previous studies, however, have compared angio to historical controls or have not controlled for the magnitude of splenic injury, making the role of angio in nonop management difficult to estimate. We reviewed all patients with splenic trauma over a 5 year period to determine the effect of angio on nonop splenic salvage rates. Data on demographics, magnitude of injury, associated injuries, outcome, and utilization of angio +/- embolization were collected. From 2000 to 2004, 570 patients were diagnosed with splenic injuries. Over this time frame, Injury Severity Score (ISS) significantly decreased (Table) while age, gender, ICU & hospital length of stay and mortality did not change (not shown). Angio use tended to increase in the later years of this period and its use was significantly greater in patients with spleen AIS 3 (30%) and AIS 4 (33%) than in patients with spleen AIS 2 (7%)($p<0.01$). The overall success rate of nonop management for this time period, however, did not significantly change (Table). The rate of successful nonop management was no different for patients who underwent angio regardless of whether they had spleen AIS 2 (nonop success with angio=94%, n=17 vs nonop success without angio=95%, n=236) or had spleen AIS 3-5 (nonop success with angio=79%, n=29 vs nonop success without angio=79%, n=66). Embolization did not affect the success rate for patients with spleen AIS 3-5 undergoing angio (nonop success with angio=80%, n=20 vs nonop success without angio=78%, n=9). In conclusion, angiography did not improve nonop success in patients with splenic trauma and the data suggest that better definition of patients who will benefit from angiography +/- embolization is required.

	2000	2001	2002	2003	2004
# pts/# angio	90/5	118/4	150/17	96/12	116/9
ISS ($p<0.01$)	30.3	25.9	23.3	24.4	21.6
Spleen AIS	2.8	2.8	2.6	2.8	2.6
Success nonop	93.8%	88.4%	92.5%	83.9%	94.0%

Trauma Center Utilization for Children with Specific Injuries Stratified by Injury Severity Score, 1998-2004

N Ewen Wang, MD, Jia Chan, MA, Pamela Mahlow, MA, David Spain, MD *, Paul Wise, MD, MPH

Major instability in the financial base of health care delivery has the potential to affect the triage of patients to trauma designated centers **Objective:** To describe hospitalization patterns in California for select pediatric injuries in trauma and non-trauma designated centers stratified by injury severity over the 1998-2004 period. **Methods:** Retrospective observational study of a population-based cohort from the California Office of Statewide Health Planning and Development (OSHPD) Public Patient Discharge Database. Inclusion criteria: age 0-19 years, trauma ICD-9 diagnostic codes and e-codes, unscheduled admissions and discharged from an Acute Care Hospital (n=111,566). Injury Severity Scores (ISS) were calculated from ICD-9 codes. ISS was classified as mild, moderate or severe. The primary outcome was hospitalization in a trauma center. Differential rates of hospitalization for children in trauma-designated hospitals versus non-trauma-designated hospitals were stratified by ISS and calculated for multiple injury, as well as for selected injury types: 1) skull or intracranial, 2) lower limb, and 3) thorax, abdomen and pelvis injured children. **Results:** From 1998-2004, 67-88% of discharges for children with multiple significant trauma and moderate or severe ISS were from trauma-designated hospitals. Similarly, 62-84% of discharges for children with moderate or severe injuries of the thorax, abdomen, and pelvis were from trauma-designated centers. Children with head injury and moderate and severe ISS were hospitalized in trauma-designated hospitals at rates of 67-79% and 72-87% respectively. Children with lower limb injuries and moderate and severe ISS were hospitalized in trauma-designated centers at rates of 53-71% and 75-87%. Trend analysis suggested no erosion in trauma center referral. **Conclusions:** It is encouraging that a majority of children with severe ISS, despite injury type, continue to be hospitalized in trauma-designated centers. However a significant portion of severe injuries in children are not cared for in trauma-designated centers. Injury type, independent of injury severity, seems to affect patterns of trauma care.

HOW CAN TRAUMA SURGEONS MAINTAIN THEIR OPERATIVE SKILLS?

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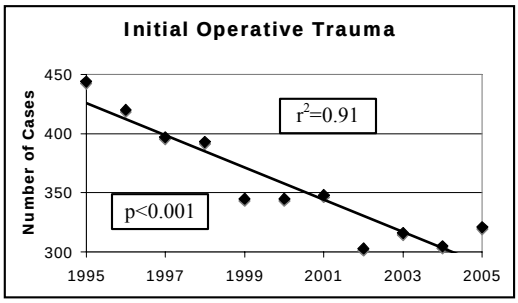
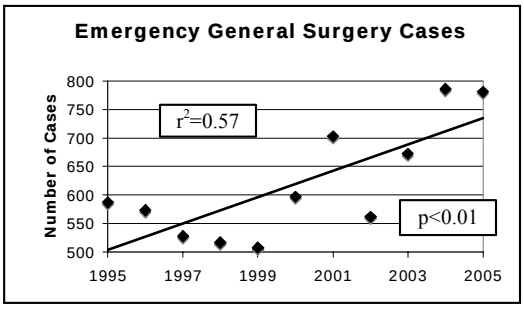
Introduction: The operative experience of the dedicated trauma surgeon is steadily declining. Much attention has focused on the operative workload of trauma surgeons in recent years as it is felt to be critical in maintaining operative skills and the interest of surgical residents in trauma careers. We examined the operative experience of our trauma service which has included both trauma and general surgery.

Methods: The operative registry at our Level I trauma center was queried from Jan 1995 to Dec 2005. The cases were classified as trauma, emergency general surgery, or elective general surgery. Data were analyzed using weighted linear regression to determine statistical significance.

Results: While the total number of cases performed by the trauma service remained constant, the proportion of initial operative trauma cases (< 24 hours from arrival to OR) decreased from 14% to 8% (r^2=0.91, $p<0.001$) over the eleven-year study period. In contrast, emergency general surgery cases increased over this time period (r^2=0.57, $p<0.01$). Elective case volume was unchanged. The majority of the decline in trauma cases was due to decreased operative liver cases, spleen cases and neck explorations.





Conclusions: Trauma operative experience decreased but emergency general surgery increased over a decade at our trauma center. It appears possible to maintain a busy operative trauma service by the inclusion of emergency general surgery consultations.

CONSEQUENCES OF OVER AND UNDERTRIAGE

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Objective: Morbidity and mortality among over and undertriage cases is not well understood, yet they are integral for evaluating the trauma system. The purpose of this study is to evaluate length of stay (LOS) and mortality among over and undertriage cases.
Methods: A matrix method was used to identify over and undertriaged cases from trauma registry data at two American College of Surgeons verified level II trauma centers in Columbus, Ohio (1999-2005), and Fort Collins, Colorado (1996-2003). Both hospitals used the same triage criteria. Injury Severity Scores (ISS) were used to define major (ISS > 15) and minor (ISS < 15) injury. Overtriage was defined as A/(A+B); undertriage equaled D/(C+D). Cases were further stratified by average LOS and mortality.

Trauma Team Activation	ISS ? 15 (Minor)	ISS > 15 (Major)	Total
Full	A	B	A+B
Limited & None	C	D	C + D
Total	A + C	B + D	A + B + C + D

Results: Out of 18,746 cases, 10,061 (55.0%) were from Fort Collins, Colorado, and 8,415 (45.0%) were from Columbus, Ohio. Over and undertriage data is presented below.

Triage Category	N	% Triage	Average LOS (days)	Mortality
Overtriage (CO)	622	51.07%	3.30	0.80%
Overtriage (OH)	424	64.96%	4.90	7.31%
Undertriage (CO)	594	6.72%	6.85	7.91%
Undertriage (OH)	485	6.25%	8.29	11.75%
Appropriate (CO)	8845	42.21%	2.62	2.27%
Appropriate (OH)	7506	28.82%	3.66	1.48%
Total (CO)	10,061			2.52%
Total (OH)	8415			2.36%

Conclusion: Using data from two level II hospitals, this study found that undertriage of trauma patients is associated with costly longer hospital LOS and poorer outcomes as measured by mortality. Future studies should be conducted to identify factors influencing over and undertriage of patients so that potential corrective actions and improvements can be made to minimize the associated increased length of stay and reduce mortality.

ABRUPT CLOSURE OF A TRAUMA CENTER: LESSONS LEARNED IN TRAUMA SYSTEM PLANNING

Adella M. Garland, MD; John P. Sherck, MD*; David D. Oakes, MD*; Susan I. Brundage, MD, MPH*, and David A. Spain, MD*, Santa Clara Valley Medical Center and Stanford University Medical Center

Background: The economic instability of the healthcare market has lead to reduction of hospital service availability with increasing frequency. Since 1985 our county had 3 trauma centers (TC), with patients directed to the closest, and transport mode determined by first responders. One TC abruptly closed leaving no time for the addition of resources. We present our experience in the six month period following the closure of a TC. **Method:** TC and EMS personnel developed a plan to equally distribute patients to the remaining TC by redefining catchment areas, increasing helicopter use for transport from distant areas, diverting all out of county transports to TC1, and better surge capacity design throughout the remaining system. Data were obtained from EMS records and TC registries: patient volume, severity, mechanisms, transport mode and times, delays, diversions, complications, and deaths were analyzed. The six month period following closure was compared with the same six month period one year prior. We continued to use the same ACS filters, hospital performance improvement (PI) and county trauma audit procedures to analyze data from the two time periods. **Results:** For the periods compared, overall trauma system volume increased by 12% (3151 to 3538). For TC1, helicopter transport increased fivefold (59 to 354), and average scene to TC1 arrival times increased by 20 minutes (18 to 38) including all transports from surrounding counties; admissions increased 39% (513 to 689). For TC2, ground ambulance increased by 95% (764 to 1487), transport times increased by 1.3 minutes (14.1 to 15.4), and admissions by 19% (715 to 850). No patients were diverted to other counties, COT criteria for MD arrival were maintained. TC and county trauma audit revealed no deaths or complications attributable to increased transport times. **Conclusions**: Despite the loss of one TC, our system was able to accommodate the re-distribution of trauma patients with no adverse outcomes related to delays or diversion. Such unexpected events, while unfortunate, can reveal excess capacity, and provide opportunities to increase efficiency and assess optimal trauma system configuration.

Discharge Outcomes of Trauma Patients who spent >30 days in the ICU

Brian M.Goodman, MD, Adrian Ong, MD, Laurel Omert, MD*, Elan Jeremitsky, MD, Jack Protetch, BS, AurelioRodriguez, MD*

Introduction: Few studies have evaluated outcomes for trauma patients with prolonged ICU stays. Our aim was to evaluate discharge outcomes for trauma patients who spent greater than 30 days in the ICU.

Methods: Patients who spent >30 ICU days over a six-year period were selected after review of the hospital trauma registry. Outcome measures were mortality and functional status at discharge using modified indicators based on the Functional Independence Measure (FIM). Patients aged 65 or greater were compared to younger patients.

Results: Of 3560 ICU admissions in this period, 160 (4.5%) stayed >30 days in the ICU. Mean age was 53 (range 13-89) years, with 38% of patients greater than 65 years. Mean Injury Severity Score (ISS) was 30, median Abbreviated Injury Score-Head (AIS-Head) was 3, mean ICU length of stay was 44 days, with a mortality rate of 12%. Discharge destinations included home (8%), skilled nursing facility (26%), rehabilitation hospital (56%) and other acute care hospitals (6%). Survivors were younger but had similar ISS and AIS-head compared to non-survivors. Median scores for functional status at discharge were (range of 1 to 4 with 4 signifying complete independence) 1 (feeding), 1(locomotion), 3 (expression), 1(transfer mobility) and 3 (social interaction). For patients >65 years, mortality was higher (24% vs 5%, p=0.001) compared to younger patients, and functional status was poorer despite lower mean ISS (25 vs. 32, p=0.0001). Thirty (19%) patients ultimately spent greater than 60 days in the ICU with a mortality rate of 4/30 (13%).

Conclusion: For trauma patients surviving > 30 days in the ICU, in-hospital mortality rate is low, with poorer outcomes in patients > 65 years. The functional status at time of discharge suggests the need for further intensive rehabilitation and medical resources beyond discharge from a trauma center.

SUGAR AND SPICE IS NOT A VICE: SEX DIFFERENCES IN BLOOD GLUCOSE FOLLOWING SEVERE TRAUMA

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Background: While elevated blood glucose (BG) is associated with increased mortality following trauma and in the intensive care unit (ICU) setting, the influence of gender on hyperglycemia has not been previously shown. Tight glycemic control is essential to improved outcomes. This study examined the hypothesis that both BG levels and the degree of BG variability is gender specific and correlates with mortality and morbidity following trauma. **Methods:** A retrospective chart review of 1510 consecutive trauma patients admitted to the ICU with a length of stay > 24 hours from 2000-2004 was performed. Demographic information, ISS and outcomes were collected. Admission BG as well as all laboratory BG levels obtained during the first week while in the ICU were analyzed. In each patient, the mean BG over 7 days and the degree of BG variability (standard deviation/mean BG) were calculated. **Results:** 1242 males and 268 females were studied. Overall mortality was 9%. 76% of deaths had a BG > 125 mg/dL on admission. Figure 1 demonstrates that the mortality rate increases as BG variability worsens. Stratified by gender, Figure 2 demonstrates a significant difference in male BG variability when comparing survivors to non-survivors. Females do not exhibit significant BG variab

FIGURE 1

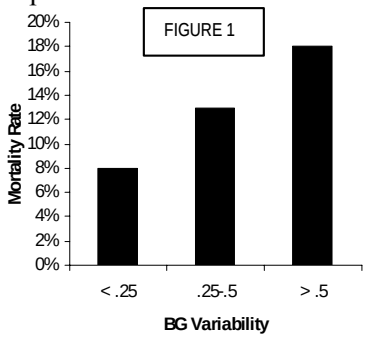
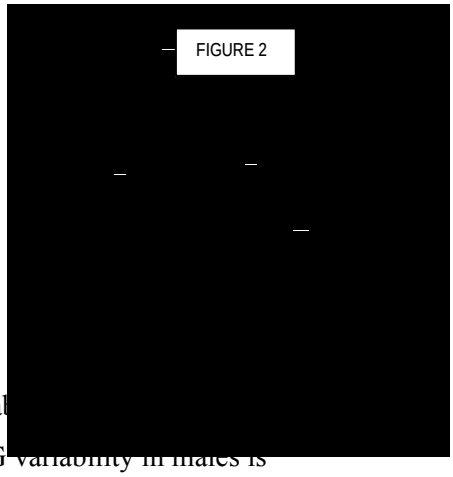


FIGURE 2



Conclusions: Both hyperglycemia as well as increased BG variability in males is associated with higher mortality following severe injury. Mortality in females cannot be predicted based on the BG levels or BG variability. These data have significant implications for gender-related differences in post-injury management.

PREDICTION OF FUNCTIONAL OUTCOME IN PEDIATRIC TRAUMA SURVIVORS

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Objective: Determine prediction variables and develop models for estimation of functional outcome in the pediatric trauma patient.

Methods: Patient Population: National Pediatric Trauma Registry (NTPR): 1994-2001. Outcome variable: abnormal Functional Independence Measure (FIM) score at discharge. Survival Risk Ratios (SRRs) and ICISS score were calculated as previously described. The Relative Head Injury Severity Scale (RHISS:min 0=no head injury, max 3= severe head injury) was calculated from ICD-9 head injury discharge diagnosis codes. Stepwise logistic regression was used to ascertain significant predictors. Model performance was assessed by area under the Receiver Operating Characteristic Curve (ROC-Az) and odds ratios were calculated for significant variables.

Results: There were a total of 50199 patients (mortality 2.9%). Of the 48740 survivors approximately 40% had an abnormal total FIM score. There were approximately 10000 cases used in the LR analysis as no effort was made to impute missing values (cases with missing values were eliminated from the analysis). The ROC-Az was 0.853 (95% CI: 0.844-0.862).

Significant Variable Predictors: Eye, Verbal Score of GCS, Intubation in the Field, Sex, Systolic Blood Pressure, Respiratory Rate, NISS, Revised Trauma Score, Number of Injuries, ICISS, RHISS, Pelvic Fracture, Mutli-system Organ Failure, Pulmonary Complication, ICU stay, Number of Days in ICU, need for extrication, Hit by a Car, Age

Nonsignificant Predictors: Motor Score of GCS, Intubation at Hospital, Heat Rate, Pediatric Trauma Score, Temperature, Weight, Height, CPR done, Race

Conclusion: This first iteration LR model yields good results for prediction of functional outcome. Refinement in the model will be possible with missing variable analysis and choice of the predictor variables. These models will extend the performance analysis of institutions to the large number of survivors instead of the traditional hospital mortality.

THE EFFECTS OF ALCOHOL ON OVER AND UNDERTRIAGE

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Background: Alcohol increases the risk of having an injury event, but does it affect triage? The purpose of this study is to assess the role of alcohol in triage among patients seen at an American College of Surgeons verified level II trauma facility, 1996 – 2005.
Methods: Injury Severity Scores (ISS) were used to identify major (ISS > 15) and minor (ISS < 15) injuries. A matrix method was used to identify patients potentially overtriaged (A/A+B) and undertriaged (D/C+D). Cases included patients greater than 10 years of age

Trauma Team Activation	ISS ? 15 (Minor)	ISS > 15 (Major)	Total
Full	A	B	A+B
Limited & None	C	D	C + D
Total	A + C	B + D	A + B + C + D

with International Classification of Disease codes 800 – 959.09. Cases transferred into the hospital were excluded. Odds ratios (OR) and 95% confidence intervals (CI) were used to compare the proportion of overtriaged individuals with evidence of alcohol to the proportion of undertriaged with evidence of alcohol. Z-test statistics were used to compare the proportion of over and undertriage cases with and without evidence of alcohol.
Results: A total of 9,346 trauma cases were identified; 973 (10.4%) were identified as over or undertriaged. Individuals 10 years of age and older with documented evidence of alcohol were 73% more likely to be overtriaged (OR = 1.73, 95% CI (1.30, 2.32)). Among over and undertriaged cases, the proportion of patients with evidence of alcohol was statistically different ($p < 0.05$) from the proportion of patients without alcohol evidence.

	No Alcohol Evidence	Alcohol Evidence	Significance
Overtriage	407/807 = 50.4%	200/353 = 56.7%	P < 0.05
Undertriage	285/7138 = 3.9%	81/1048 = 7.7%	P < 0.05

Conclusion: Overtriage of patients with alcohol evidence may stem from our triage criteria, namely, the motor component of the Glasgow Coma Scale. Conversely, among undertriaged patients, evidence of alcohol may mask signs and symptoms of underlying traumatic injuries which potentially increase morbidity and mortality.

A NOVEL BIOLOGIC HEMOSTATIC DRESSING (BHD) STOPS ARTERIAL HEMORRHAGE AND PROVIDES LONG TERM HEMOSTASIS IN A SURVIVAL MODEL OF AORTOTOMY IN SWINE

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Background: Hemorrhage remains the leading cause of potentially preventable death in military and civilian trauma. No hemostatic product is available that can both stop life-threatening arterial bleeding and sustain long term hemostasis. We evaluated the efficacy of a new dressing to stop lethal arterial hemorrhage and maintain long term hemostasis. **Methods:** The BHD's were 4x4 in. flexible conformable dressings composed of human biologic proteins and an absorbable synthetic matrix. Anesthetized pigs (34.7±2.6 kg) were chronically instrumented for blood sampling and remote vital signs monitoring. An infrarenal aortotomy was created with a 4.4-mm aortic hole punch and free bleeding was controlled by applying the BHD on the aortotomy with a 3 min compression (n=8) or by suturing the vessel (n=2). Once hemostasis was achieved, the abdominal cavity was closed and the animal monitored for 2 wks. Hematological measurements and CT scans were performed on post-op day 1, 7 and 14. Animals were euthanized at 2 wks and the vessels, dressings and organs were recovered for histology. **Results:** Initial hemostasis was achieved in all animals (10/10) and was maintained for 2 wks in 9 of 10 pigs. One pig exsanguinated due to dressing failure 2 hrs post-op. Survival pigs resumed normal activities and gained an average 4.4 kg weight. Hematological values (RBC, WBC, Platelets, PT, aPTT) remained unchanged from pre-injury levels except ~2 fold increase in the fibrinogen level on day 1 in both groups. CT images of BHD treated animals showed 2-10 mm pseudoaneurysm (PA) at the aortotomy site which decreased in size after 2 wks. Histologically, the PA's were filled with laminated fibrin, PMN's, macrophages and fibroblasts. Bowel adhesions were minimal at BHD sites and no emboli were detected in the distal organs. No PA's were seen in sutured vessels. **Conclusion:** The new BHD offers an easy, rapid and effective method to stop high pressure arterial bleeding. Although BHD does not prevent a PA, it seals the aortotomy and provides 2-week hemostasis in 88% of animals without any other side effects. Longer-term evaluations are currently underway.

BEDSIDE PLACEMENT OF PROPHYLACTIC REMOVABLE VENA CAVA FILTERS BY INTRAVASCULAR UNTRASOUND

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Background: Bedside placement of removable inferior vena cava filters (RIVCF) is increasingly used in critically injured patients. The need for fluoroscopic equipment and specialized ICU beds and rooms presents major challenges. Intravascular Ultrasound (IVUS) eliminates such problems and offers an attractive alternative to surgeons trained in RIVCF placement.

Methods: The medical records of the first 37 critically injured patients who had IVUS-directed RIVCF were reviewed (10/2004 – 2/2006). All patients were at high risk for pulmonary embolism and 24 had a contraindication for prophylactic heparin. Complications and rates of RIVCF removal are reported.

Results: The mean age was 41$\pm$20 years and Injury Severity Score 32$\pm$11. The right (33) or left (4) common femoral vein was chosen as the site of access in all. Placement at the ICU bedside was performed in 32 patients, while 3 had it in the angiography suite and 2 in the operating room. The Guenther-Tulip® filter (COOK, Bloomington, IN) was used in 34 patients and the Recovery® (BARD, Tempe, AZ) in 3. Two patients (5%) developed common femoral DVT (6 and 13 days after RIVCF insertion) and one of them a peripheral PE. In 2 patients (5%) there were technical misadventures: 1 misplacement requiring reposition under fluoroscopy (first case in the series) and 1 access site bleeding requiring blood transfusion; these patients suffered no further morbidity related to RIVCF. One more patient early in the series required fluoroscopy due to inability to safely determine the proper anatomical landmarks by IVUS. Within a follow-up period of 1 to 12 months, removal of RIVCF was attempted in only 4 patients and successful in 3.

Conclusions: IVUS-guided bedside placement of RIVCF is feasible and safe, if immediate access to fluoroscopy is available for technically challenging cases during the learning curve. The rate of removal is disappointingly low and its causes need to be further explored.

THE ADEQUACY OF STANDARD TWICE-DAILY ENOXAPARIN DOSING IN CRITICALLY ILL TRAUMA PATIENTS AS DETERMINED BY ANTI-Xa LEVELS

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BACKGROUND: Enoxaparin is generally thought to provide effective prophylaxis for venous thromboembolism (VTE). However, studies in trauma patients have delivered conflicting results. Anti-Xa levels are used to measure the activity of Enoxaparin and levels below the recommended prophylactic range (0.1-0.3 IU/mL) are associated with higher rates of VTE. Recent studies have demonstrated that surgical ICU patients have inadequate Anti-Xa levels, which could account for the mixed results in previous trials.

OBJECTIVE: to determine the risk factors for inadequate anti-Xa levels in critically ill trauma patients receiving 30mg of Enoxaparin twice daily**.**

METHODS: 24 trauma patients in the ICU of a level-1 trauma center were studied. All patients received at least 3 doses prior to drawing peak (4 hrs. after dose) and trough (30 min. prior to next dose) Anti-Xa levels. Data regarding patient demographics, laboratory values, and complications were retrieved from the medical record. Patients with adequate and inadequate peak Anti-Xa levels were compared.

RESULTS: In the 24 patients, there were 22 peak levels and 21 trough levels available for review. Patient characteristics were as follows: mean age 43 yrs, mean ISS 19, 92% male, 19 (79%) developed SIRS, 12 (50%) developed Sepsis, 10 (42%) had peripheral edema, and 3 (13%) developed VTE. Six patients (27%) had inadequate peak Anti-Xa levels and 100% had inadequate troughs. Creatinine clearance and BMI were significantly higher in the patients with inadequate peak Anti-Xa levels (263 vs 177 ml/min, p=0.044 and 43 vs 29, p=0.026). Gender, weight gain, edema, bilirubin level, albumin level, INR, SIRS, and Sepsis were not different between the two groups. Of the three patients who developed VTE, 2 had adequate peak levels, but all 3 had inadequate troughs.

CONCLUSION: Elevated creatinine clearance and BMI are risk factors for inadequate peak Anti-Xa levels. The 12-hour dosing interval led to inadequate trough levels in all patients. Future studies are needed to identify the optimal dosing regimen.

WEIGHT OF OBESITY ON LOWER EXTREMITY VASCULAR INJURIES

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Objective: While severe clinical obesity is an epidemic problem in the United States, the impact of this disease upon traumatic lower extremity vascular injuries is as yet undefined. We hypothesized that clinical obesity adversely affects outcome in patients with traumatic lower extremity vascular injuries. **Methods:** All adult patients admitted with a traumatic lower extremity vascular injury were identified for a five-year period. Demographic, management, and outcome data were abstracted by retrospective chart review. Patients without attempted surgical revascularization and patients without adequate data to determine body mass index (BMI) were excluded. Clinical obesity was defined as body mass index (BMI) > 30. Obese and non-obese patient groups were compared for surgical management and outcome, using chi-square and Student t-test as appropriate. **Results:** A total of 145 patients were identified. BMI data were available for 115 (79.3%) of these patients (obese n=47; non-obese n=68). Obese and non-obese groups were similar in age, ISS, mechanism of injury and base deficit. No statistical difference was seen between groups for amount of blood transfusion, wound infection, renal complications and LOS. Obese patients had more vascular repairs (34/47, 72%) than non-obese patients (22/68, 32.3%) (p= 0.044). No statistical differences were found in frequency of vascular ligation between groups (p=0.46). Amputation rate (obese 6/47, 13% versus non-obese 4/68, 5.8%, p=0.22) and mortality (obese 4/47, 8.5% versus non-obese 1/68, 1.4%, p=0.10) were not significantly different. Obese patients were discharged more frequently to a rehabilitation facility (obese 15/47, 32% versus non-obese 7/68, 10%, p= 0.005). **Conclusion**: Clinically obese patients with lower extremity traumatic injuries requiring revascularization attempts required more vascular repairs and rehabilitation than the non-obese, but overall had similar outcomes. Appropriate allocation of resources to this group of critically injured patients including early rehabilitation efforts and recognition of surgeon work effort should allow similar long-term outcomes to be achieved.

Anatomic Distribution of Deep Venous Thrombosis in Traumatically Injured Patients

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Background: Few studies have evaluated the distribution of proximal DVTs in trauma patients. Our objective was to evaluate the anatomic distribution of deep venous thrombosis (DVT) and time to diagnosis of DVT and pulmonary embolism (PE) in traumatically injured patients.

Methods: Patients admitted to a level 1 trauma center for ? 48 hours were evaluated for the diagnosis of proximal DVT or PE over a 2 year period. The diagnosis of DVT was confirmed by either venogram, venous duplex or CT venogram. VQ scan and CT were used for the diagnosis of PE. All patients received standardized DVT prophylaxis with sequential compression devices and either low molecule weight or lose dose unfractionated subcutaneous heparin. The presence of DVT, distribution of clot, presence of pulmonary embolism, days to diagnosis of DVT or PE, and mechanism of injury were all evaluated.

Results: A total of 102 of 4773 (2%) patients were diagnosed with DVT or PE over the study period. The mean age was 45.5 ± 19 years and was mostly admitted for blunt mechanism (83%). There were a total of 79 DVTs identified in 102 patients. The mean time to diagnosis of DVT was 11 ± 10 days. Seventy-two percent of the DVTs were in the lower extremities while 28% were located in the upper extremities. The distribution of DVT in the upper extremities were subclavian = 30%, axillary = 27%, internal jugular = 23%, brachiocephalic = 13%, and innominate = 7%. The distribution of DVT in the lower extremities were common femoral = 37%, superficial femoral = 26%, popliteal = 26%, iliac = 9%, and infrarenal IVC = 2%. In the 45 patients with PE, DVT was diagnosed in only 7 patients (5 lower and 2 upper extremity). Mean time to diagnosis of PE was 8 ± 7 days.

Conclusion: Of the DVTs diagnosed, the majority occurred above the knee and was diagnosed within the first two weeks of admission. The majority of PE's were diagnosed without a concomitant DVT.

TRAUMATIC PERIPHERAL ARTERIAL INJURIES IN CHILDREN

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Vascular trauma is a rare event in the pediatric age group. There is a paucity of data on the care of children with peripheral vascular trauma and in particular arterial injury. We reviewed our experience to assess the presentation, management and outcome issues.

Methods: The trauma registry database was used to identify all peripheral vascular injuries in children under the age of 18 over the past 10 years. The medical records of all patients were reviewed for data pertaining to demographics, presentation, management and outcomes. IRB approval was obtained prior to commencing the study.

Results: Of a total of 5706 patients admitted with trauma during the study period, we found 101 patients with 137 peripheral arterial injuries (1.8%). 82% were males and 2/3 of the patients were African American (AA). The mean age was 13.3 years (range 1-17 years). The table breaks down the distribution according to the three most common mechanisms of injury.

MOI	n	Age years	Sex %male	Race %AA	ISS	LOS (days)	Vessels injured	Amputation
GSW	40	15.5	92.5*	77.5*	11±5.9	9.5±11.9	Brachial 28% Femoral 28%	4 (10%)
MVC	21	14.4	57.1	38.1*	14±13*	13.6±8.8*	Post Tib 19% Ulnar 14%	6 (28.60%)
Stab	16	13.3	87.5*	87.5*	6±2.9*	5.4±4.3*	Radial 38% Ulnar 31%	1 (6.25%)

(* $p<0.05$, unpaired t test, test of proportions) (comparing MOI to each other)

Most amputations (9/13) were in AA. Associated injuries were noted with peripheral nerves (36.6%) and tendons (18.5%). Prostheses were utilized in only 5 cases (4/5 white,1/9 AA), and 43.6% were in some form of rehabilitative care at average follow up of 6 months post discharge.

Conclusions: Peripheral arterial injury in children is rare, but has a substantial morbidity. GSW were seen more often in older AA males, which is from urban violence. Prosthetic application and usage was poor despite reasonable rehab care.

THE SIMULATED TRAUMA PATIENT TEACHING MODULE - DOES IT IMPROVE STUDENT PERFORMANCE?

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Objective: Student feedback from the old TEAM (Trauma Evaluation and Management) program prompted introduction of simulated trauma patient models in the new program. Performance after the new and old programs was compared to assess the impact of the simulated patient models.

Methods: Final year medical students randomly assigned to control and experimental groups completed a 20 item trauma MCQE. The experimental groups attended the old or new TEAM programs before completing a second MCQE and the control groups completed the same post-test without the TEAM programs. Using paired "t" tests for within groups and unpaired "t" tests for between groups, we compared the control and experimental groups' performance in the MCQ pre and post-tests for both the old and new programs. On a 1- 5 scale, students graded: objectives met; trauma knowledge improved; trauma skills improved; overall satisfaction; TEAM should be mandatory.

Results: Means, with Standard Deviation in brackets:

	Control			**Experimental**		
	N	**Pre (%)**	**Post (%)**	**N**	**Pre (%)**	**Post (%)**
Old	16	52.5 (14.1)	50.9 (11.3)	16	48.0 (9.8)	75.3 (8.8)
New	17	50.5 (6.7)	51.5 (4.6)	21	50.5 (6.7)	81.4 (4.4)

Post-test scores increased significantly after both the old and new programs but the increase was statistically significantly greater after the new program. In the old TEAM, 51.6% rated improvement in trauma skills at 4 or greater compared to 97.3% in the new program. A large percentage of students in the old program requested more hands-on teaching. None in the old program compared to 85% of students in the new program achieved a criterion referenced honors mark of 80%.

Conclusion: Simulated trauma patient models were rated highly and improved both trauma skills and knowledge. Wider application of these teaching models is suggested.

TEACHING MEDICAL STUDENTS HOW TO BREAK BAD NEWS: A NOVEL MIXED REALITY SIMULATION BASED CURRICULUM

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Breaking bad news (BBN) is an integral part of the practice of trauma though receives little attention in training. We hypothesized that creating a simulator-enhanced, formative experience to teach BBN will increase the preparedness for and comfort for this skill. Methods: 191 third year medical students related their prior experience with BBN and their self assessed comfort level and then were divided as follows: Group 1 (n=95) received no training prior to speaking with the a Standardized Patient Wife(SPW) after an unsuccessful resuscitation of a human patient simulator with multiple gun shot wounds. Group 2 (n =96) received a lecture and practiced for 1 hour in small groups prior to the resuscitation and BBN. After the encounter, students completed a self assessment and were evaluated by the SPWs on a 5 point Likert scale on 21 items related to appearance, communication skills, and emotional affect. Group 1 students received cross-over training after the encounter. Results: Both groups self assessed ability to BBN ($p< 8.3 \times 10^{-30}$), and ability to have a plan ($p< 7.7 \times 10^{-34}$) improved significantly over base line with greater improvement in group 2 ($p <.016$ & $<.0016$). Group 2 (pre-trained) students were rated superior by SPW's in terms of their comfort level ($p <.004$); whether they had a plan ($p <.0002$); assessment of information the SPW already knew ($P<.5.5 \times 10^{-9}$), preparation of the SPW to receive news ($p <.003$); and ability to provide guidance ($p <.02$). Upon questioning at the conclusion of the rotation 12 weeks later self assessed skill in BBN and having a plan had decreased (3.78 +/- .57 to 3.62 +/- .68 and 3.83 +/- .58 to 3.65 +/- .70) but remained significantly improved over baseline ($p<9.4 \times 10^{-17}$ & $p<7.7 \times 10^{-18}$)

Conclusion: This novel approach to teaching BBN to 3rd year medical students was well received by the students and resulted in marked improvement of self assessed skills over baseline immediately and 12 weeks later. Coupling this experience with a didactic and small group practice greatly enhanced the performance of student's ability to BBN and will serve as a model for our future curricular development.

IS "RELATIVE BRADYCARDIA" TRULY PROTECTIVE IN HYPOTENSIVE TRAUMA PATIENTS?

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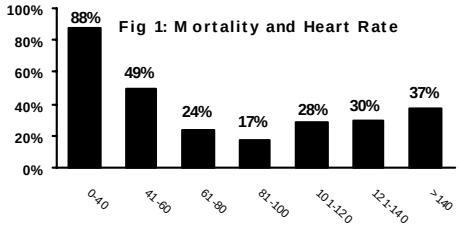
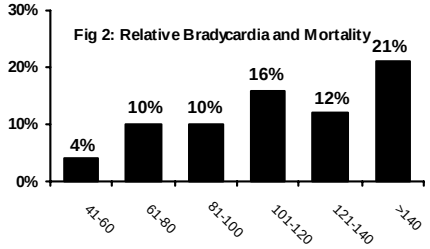
Background: Despite classical teaching, hypotension is not always associated with an increase in heart rate (HR). Recent evidence suggests this "relative bradycardia" may be protective and improves outcome. **Objective:** To determine the relationship between HR and mortality in hypotensive (SBP <90) trauma patients. **Methods**: Ten year study at a Level I trauma center. The first HR in hypotensive patients on arrival was identified and its relationship to outcome determined. **Results**: 47,012 trauma patients were retrospectively evaluated and 1756 (3.7%) were hypotensive. Patients with incomplete data (185) and DOA (524) were excluded. The average BP was 64±29, the ISS 20±16 and the mechanism was primarily blunt (75%) in 1047 patients. Tachycardia (HR >100) was seen in 53%, HR 60-100 in 42% and HR < 60 in 5%. There was a bimodal distribution of death (figure 1). Patients with HR between 60-100 had significantly lower mortality rate compared to HR <60 and >100 (20% vs. 62% and 32%, p<0.001). To further examine the relationship of HR and mortality, patients in extremis (HR <40, SBP < 60 and severe head injury) were excluded for subset analysis. Fig 2 shows that the relationship between HR and mortality becomes more linear and that HR <100 is associated with better survival (p<0.02). **Conclusions:** Only 53% of hypotensive trauma patients are tachycardic and patients with a HR of 81-100 have the lowest mortality. The bimodal relationship between HR and mortality becomes linear after patients in extremis are excluded. Although lower mortality is seen in patients with "relative bradycardia," this is only true in patients without extremis.





Renal Dysfunction in Trauma Patients: Even a Little Costs a Lot

Mary-Margaret Brandt, MD* , Anthony Falvo, DO, Ilan Rubinfeld, MD, Dionne Blyden, MD, Joe H. Patton, Jr.*, H. Matilda Horst, MD*

Introduction: Renal failure requiring dialysis is recognized as a significant negative outcome; however, mild to moderate renal failure is often minimized in its impact on the care of the patient. Hypothesis: Any amount of renal dysfunction is deleterious in the ICU. **Methods:** Patients discharged from our Surgical Intensive Care Unit (SICU) who had ICD-9 codes 800-959.9 were identified using our trauma registry, TRACS and the institutional administrative data base. There were two groups of patients: No Renal Failure (NRF), and Renal Failure (RF). We used 3 different definitions of renal failure: creatinine >1.5, increase in creatinine by more than 50%, or increase of creatinine by 0.5mg/dl to identify the RF group. This study was approved by the institutional IRB. General linear model was used to analyze the data. **Results:** Six hundred thirty-one trauma patients were admitted to the SICU over 24 months. Average age was 46 years (18-94), 73% were male, and 61% were African-American. Mortality was 8.8%. There were 146 patients with RF. Average number of ventilator days for NRF was 2.9 (range 0-111), LOS was 9.7 ± 11.2 (range 1-106). Average cost for NRF was $28,520(range $2,500-$389,564). The table shows the change in LOS, Cost, and Vent Days compared to NRF patients. Only 7 patients were dialyzed.

* = p <0.001	↑LOS	↑Cost	↑Vent Days
Increase of Creatinine by 1.0	+ 2.66*	+ $9,502*	+ 2.7*
RF requiring Dialysis (n=7)	+ 14.9*	+ $16,677*	+ 15*

The odds ratio for mortality for each change of 1 in creatinine from baseline was 1.45(CI 1.16-1.82)). When using any of the definitions of renal failure, odds ratio for mortality compared to those patients without renal failure was 7.06(CI 3.91-12.76).

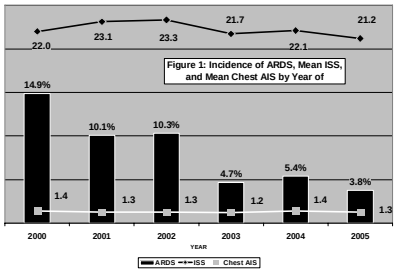
Conclusion: Renal failure requiring dialysis is recognized as particularly costly; however we demonstrated that even mild to moderate renal failure increases LOS, vent days and cost in trauma patients. Aggressive vigilance in the early recognition of mild renal failure to prevent renal failure requiring dialysis is warranted.

CONTRIBUTING FACTORS TO THE DECREASING INCIDENCE OF POST-TRAUMATIC ACUTE RESPIRATORY DISTRESS SYNDROME

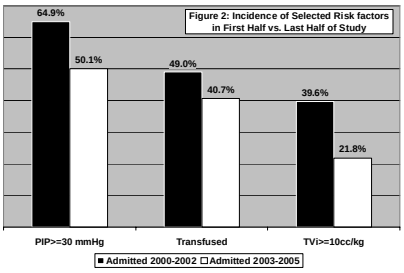
Peter Rhee, MD MPH* (LAC+USC), Matthew Martin, MD (MAMC), Carlos Brown, MD (LAC + USC), Ali Salim, MD* (LAC + USC), Demetrios Demetriades, MD, PhD (LAC + USC), Howard Belzberg, MD * (LAC + USC)

Introduction: A reduction in the incidence of post-traumatic Acute Respiratory Distress Syndrome (ARDS) has been demonstrated. It is hypothesized that ventilation strategies and restrictive transfusion policies are contributory. The purpose of this study is to examine the changes in ventilation and transfusion parameters over time and their associations with post-traumatic ARDS.

Methods: The SICU and blood bank databases from a level I center over a 6 year period were analyzed. All mechanically ventilated trauma patients were screened for ARDS with onset after 48 hours of admission. Demographic, injury, resuscitation, ventilation parameters, and transfusion data were extracted. Variables were analyzed for significant changes during the duration of the study and independent associations with ARDS were determined.



Results: There were 2346 eligible patients and 192 (8.2%) of them met criteria for ARDS. There was a significant decrease in the incidence of ARDS by year (fig. 1). When comparing the first and second half of the study, there was a significant decrease in the percentage of patients transfused, patients with a peak inspiratory pressure (PIP) $\geq$ 30 mmHg and patients ventilated with a tidal volume/kg (TVi) $\geq$ 10 cc/kg (fig. 2). Early transfusions, PIP $\geq$ 30 mmHg, and fluid balance $\geq$ 2 liters in the first 48 hours of admission were independently associated with ARDS. **Conclusions:** The increasing use of restrictive transfusion policies and ventilation strategies that potentially limit elevations in early peak inspiratory pressures may contribute to the decreasing incidence of post-traumatic ARDS.



Early Coagulation And Inflammatory Status Improves Prediction Of Mortality In Burn and Non-burn Trauma Patients

Myung S. Park, MD, Charles E. Wade, PhD, Jingjing Wang, MSc, Wenjun Martini, PhD, Leopoldo C. Cancio, MD*, Anthony E. Pusateri, PhD, Steven E. Wolf, MD, Kenneth G. Mann, PhD, John B. Holcomb, MD*

Objective: After injury, there is a synergistic response between inflammation and coagulation systems. We hypothesized that markers of these processes and, standard clinical indices will improve early prediction of in-hospital mortality in non-burned and burned trauma patients.

Methods: Patients admitted to the Surgical or Burn ICU within 24 hours of injury with an anticipated stay $\geq$3 days were enrolled over one year. Admission blood was drawn for Thromboelastography (TEG), plasma based clotting assays and cytokine levels. Upon admission clinical indices and Multiple Organ Dysfunction Syndrome (MODS) score were recorded. Multiple logistic regressions with stepwise selection and likelihood ratio test were performed to identify predictors for mortality. Candidate variables evaluated were age, % Third degree burns (FT), Inhalation Injury (II), % Total body surface area burns, IL-6, TNF, IL-8, PT, PTT, fibrinogen, D-dimer, R time, α angle (rate of clot formation), Maximal Amplitude (MA) reflective of clot strength, group (non-burn or burn) and admission MODS. A receiver operating characteristic (ROC) curve was constructed to assess the diagnostic performance of identified predictors.

Results: We enrolled 58 patients: 33 non-burned patients (20 blunt and 13 penetrating) and 25 Burn Patients (8 with inhalation injury). Fifteen deaths occurred (5 Non-burned and 10 Burn Patients). The final candidates for the logistic model were Age, % FT, II, TNF level, MA and MODS score with an Area under ROC curve of 0.96**.**

Conclusion: Our model improves prediction of in-hospital mortality in comparison to previous methods for burn and non-burn trauma patients. Furthermore, our model is applicable to all patients regardless of type of traumatic injury (burn or non-burn). This improvement is due to inclusion of patient's early coagulation and inflammatory status in addition to standard clinical indices.

Risk Factors for Tracheal Stenosis in Intubated Trauma Patients

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Objective: Tracheal stenosis is a complication of trauma, co-morbid disease, infection, and iatrogenic injury from intubation, mechanical ventilation and tracheotomy. The clustering of several cases of symptomatic tracheal stenosis in mechanically-ventilated trauma patients prompted this investigation of risk factors associated with its occurrence.
Methods: Non-concurrent case-cohort study conducted at a Level I trauma center. The registry was queried for all adult patients intubated for at least 48 hours during the 13-month period from October 1 2003 – October 31 2004. One hundred sixty-three charts met criteria and were reviewed for patient issues (injury severity, instability, comorbidity, complication), intubation factors (location of intubation, size, type of tube) and ventilation variables (duration, mode of ventilation, cuff pressures, number of reintubations, airway pressures, PEEP).
Results: Eleven cases were identified during the study period, all of which were symptomatic on presentation. Tracheal stenosis occurred in young (mean age 29.6, S.D. 9.9), male patients with blunt mechanism (90.9%) and significant injury severity (mean 27, S.D. 14.7) No differences were found between cases and non-cases in the consideration of patient factors. The mean interval to presentation with this complication was 84 days (range 15-192, S.D. 62.5). Intubation variables were compared, and significant differences were found in endotracheal tube size (<= 7.5 vs. >= 8, O.R. 9.6, 95% C.I. 1.2-76.9, p=.009) and type (subglottic aspiration-type tube vs. standard, O.R. 6.2, 95% C.I. .77-49.5, p=.046) No other significant differences were found in ventilation variables between the groups.
Conclusion: Endotracheal tube size and type are associated with tracheal stenosis and may represent modifiable risk factors for the prevention of this complication in our trauma patient population.

A PROSPECTIVE COMPARISON OF ROUTINE CXR VS. CLINICAL JUDGMENT FOR THE DETERMINATION OF ADEQUATE CENTRAL LINE PLACEMENT

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Introduction: Central venous catheterization (CVC) is routine in the management of critically ill patients. However, this procedure has recognized complications, generally mandating a post-procedural chest radiograph (CXR) to confirm adequate position. We sought to determine if CXR following CVC was necessary, or if clinician judgment could reliably predict complications and malpositioning, obviated the CXR.

Methods: Prospective observational study of patients undergoing central line placement in the Trauma/Surgical and Burn ICUs over the seven month period ending Feb. 2006. Following placement, a brief questionnaire addressing co-morbidities, and the technical aspects of the procedure, was completed, and a confirmatory CXR was obtained.

Results: 138 CVCs were performed in 109 patients (mean age of 49 ± 23 years). The population was 56% burn and 44% trauma or general surgery patients. 56% of the population was obese (15% morbid). The subclavian position was used in 72%. 95% of lines were without complication, while 4% were malpositioned and 1% resulted in pneumothorax (delayed diagnosis at 24 hours). The incidence of complications was not impacted by level of training of the physician placing the line, the site of insertion, or number of attempts necessary to access the vein. Clinical judgment correctly identified malpositioning in 17% of cases, and pneumothorax in 50% of cases. 72% of CVC placement was felt to be uncomplicated by the person placing the line (5% complication rate), while 25% were felt to be technically difficult (3% complication rate), and the remainder were either probable complications or technically unfeasible (100% complication rate). Overall, clinical judgment had a sensitivity of 74%, specificity of 11%, PPV 96% and NPV 11%.

Conclusion: Chest x-ray following CVC placement in the critically ill should remain the standard of care. Clinical judgment cannot reliably predict malpositioning of a CVC or the presence of post-procedural complications.

A TWO-MINUTE TRIAL IS A RELIABLE PREDICTOR OF SAFE EXTUBATION

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Background: Mechanical ventilation of surgical patients is a common finding in the Surgical ICU (SICU). Clinicians are challenged with safely predicting the optimal time of extubation. The objective of this study was to describe a two-minute trial which safely and reliably predicts successful extubation in a 20 bed SICU in a level I urban trauma center. **Methods:** Data was retrospectively collected in an SICU from 1/1/04 to 12/31/04 (IRB approval granted). Pre-trial extubation criteria included: i) hemodynamic stability (SBP>90 mmHg, 10<RR<30, 60<HR<110 bpm, O_2Sat>90%), ii) GCS>10t, iii) lack of any chemical paralysis or sedation, and iv) clinical indication for extubation. Once the above criteria were met, the patients were physically disconnected from the ventilator (while intubated) for a two minute trial. A decision to extubated was made if the patient remained stable (as described above). Results are reported as Mean $\pm$SD. **Results:** There were 230 patients (110 male and 120 female) who required ventilatory support. Mean age was 59 $\pm$ 20. APACHE score on admission was 24$\pm$7. SAPS score was 15$\pm$5. ICU length of stay was 6 $\pm$8 days. Hospital length of stay was 22 $\pm$19 days. Intubations period was 3$\pm$3 days. Reasons for intubation included post-operative management (n=151; 66%), altered mental status (n=48; 21%), respiratory distress (n=28; 12%) and Code Blue status (n=3; 2%).

	Pre-trial	Post-trial
Heart Rate	94$\pm$18	97$\pm$17
Respiratory Rate	18$\pm$6	20$\pm$6
Oxygen Saturation	98$\pm$2	96$\pm$4

Mean $\pm$ SD; p>0.05

Successful extubations occurred in 216 patients (94%). Fourteen patients (6%) required reintubation. Elapsed time prior to reintubation was 28$\pm$8 hours. Reasons for reintubations included respiratory distress n=12 (86%) and altered mental status n=2 (14%). **Conclusion:** The two-minute trial is a safe and reliable objective predictor of successful extubation.

IS UPPER EXTREMITY DEEP VENOUS THROMBOSIS UNDERDIAGNOSED?

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Background: Reports indicate that upper extremity deep venous thrombosis (UE-DVT) is as common and dangerous as lower extremity DVT. Routine screening of upper extremities is not performed. Pulmonary embolism (PE) is often found in the absence of lower extremity DVT. We hypothesized that UE-DVT is underdiagnosed and undertreated and that aggressive diagnosis and treatment will reduce the PE rate.

Methods: 1) Retrospective review of trauma registry over a period of 5 years without a policy of routine screening for UE-DVT and 2) Prospective evaluation of a 6-month period with a policy of routine weekly Duplex screening for UE-DVT of all trauma patients at high risk. Outcomes were the rates of UE-DVT and PE.

Results: During the prospective evaluation a total of 130 Duplex scans were performed in 86 high-risk patients of 1,085 trauma admissions; the first scan was done in 4±4 days after admission. Only 1 brachial DVT was found on an asymptomatic patient with a central line at that site and prophylactically anticoagulated since admission.

	Retrospective (1/2000-12/2004)	*Prospective (1/2005-6/2005)*
Patients	10,177	1,085
Age	49±25	49±22
ISS	18±16	18±11
UE-DVT	9 (0.0009%)	1 (0.001%)
PE	41 (0 with UE-DVT)	1 (0 with UE-DVT)

Conclusion: UE-DVT is an uncommon event and its significance still unclear in trauma. Aggressive screening does not result in a higher rate of diagnosis, nor an opportunity to prevent PE, and therefore is not warranted.

"MINI-DOSE" FACTOR VII FOR REVERSAL OF TRAUMATIC COAGULOPATHY

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Objective: Moderate coagulopathy following injury is generally treated with fresh frozen plasma (FFP). Response can be variable, thus complete correction may take hours and require large volumes of fluids. High-dose factor VIIa (FVIIa, NovoSeven^{tm}) has been used off-label to treat severe coagulopathy following trauma. Expense has limited use. Recently, we began administering "mini dose" FVIIa (1.2 mg) to patients with mild to moderate coagulopathy after trauma, hypothesizing that it would be effective and safe.

Methods: We retrospectively reviewed consecutive patients who received "mini dose" FVIIa over an 18 month period. Demographics, injury and laboratory data were abstracted as were indications for use, source of coagulopathy, effectiveness, and complications. Means and frequency data are presented and paired t-test was used to determine changes in prothrombin time (PT) and blood product utilization.

Results: 63 patients received 66 "mini doses" of FVIIa (mean 16 ±9.2 mcg/kg). Mean age was 51 (±21) years and 73% were male. The etiology of coagulopathy was; TBI (39%), cirrhosis (14%), warfarin and/or platelet inhibitor use (26%), sepsis/MODS (11%) and hemorrhage (9%). 3 doses were given prophylactically to Jehovah's Witnesses. Timing of use was intraoperative (33%), preoperative (24%), postoperative (3%), and pre-procedure (21%). Mean PT fell from 16.7 seconds (±2.7) to 10.5 seconds (±1.5) ($p<0.0001$). Patients received a mean of 6 units (±5.6) of FFP before and 1.9 units (±3.1) following rFVIIa ($p<0.0001$). All patients had a good clinical response with no bleeding complications.

Conclusion: "Mini dose" FVIIa rapidly and effectively treats mild to moderate coagulopathy following injury. "Mini dose" (1.2 mg) FVIIa is the smallest available unit dose. It costs approximately the same as 6 units of FFP and may be cost-effective in patients who require high volume factor administration. "Mini dose" FVIIa should be considered in coagulopathic trauma patients who are not in shock who require rapid normalization of clotting function.

ENTERAL PLASMA INFUSION REDUCES RESUSCITATION REQUIREMENTS AND ATTENUATES TISSUE DAMAGE IN A SEVERE PORCINE HEMORRHAGIC SHOCK MODEL

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OBJECTIVE: Intraluminal pancreatic proteases have been implicated in multiorgan dysfunction syndrome associated with hemorrhagic shock. Enteral administration of the broad-spectrum serine protease inhibitor nafamostat mesilate (Futhan™) has been shown to reduce neutrophil activation and transfusion requirements in a pig hemorrhagic shock model. We investigated whether enteral infusion of plasma, containing endogenous protease inhibitors, would reduce fluid requirements and attenuate tissue damage in a porcine hemorrhagic model.

METHODS: Yorkshire pigs were divided into 6 groups: sham-shock (SS, n=4), shock (S, n=6), shock+GoLYTLEY™ (G, n=11), shock+Futhan (F, n=9), shock+plasma (P, n=3) and shock+plasma&Futhan (PF, n=5). Hemorrhagic shock (30ml/kg) was maintained for 60 minutes followed by resuscitation with LR and shed blood to maintain a MAP $\geq$60mmHg for 3 hours. Once resuscitated, GoLYTLEY, Futhan, plasma, or a combination were delivered via a duodenal catheter to the respective groups. Total fluid resuscitation, duodenal protease levels, and histological tissue injury (small bowel, liver and lung) were compared between the 6 groups.

RESULTS: All treatment groups (G, F, P, PF) required less fluid than the S groups ($p<.05$). With the exception of the S group, all groups had reduced duodenal protease levels after hemorrhagic shock. The S group had a worse histological score when compared to the SS group($P<.05$) and the administration of any combination of protease inhibitor resulted in a significantly improved histological score for both gut and liver tissues but not lung.

CONCLUSION: Plasma was as effective as Futhan when administered enterally in reducing resuscitation requirements and attenuating gut and liver tissue damage in a pig hemorrhagic shock model.

THE DECREASING INCIDENCE OF POST-TRAUMATIC ACUTE RESPIRATORY DISTRESS SYNDROME: THE POTENTIAL ROLE OF LEUKOCYTE REDUCTION

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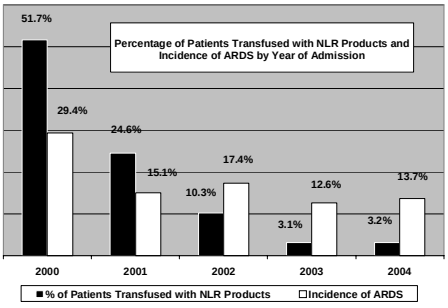
Introduction: Transfusions are associated with multiple complications including Acute Respiratory Distress Syndrome (ARDS) and death. Leukocyte reduction (LR) of blood products can potentially attenuate deleterious effects of transfusion but has not been consistently shown to decrease mortality. We hypothesize that LR contributes to a decreasing incidence of post-traumatic ARDS in patients who require transfusion.

Methods: The SICU database and transfusion records covering a 5 year period from a level I center were analyzed. All ventilated trauma patients who received transfusions within 48 hours of admission were included and screened for ARDS. Demographic, injury, resuscitation, selected ventilation parameters, and transfusion data (LR vs. non-LR exposure) were extracted. Variables were analyzed for significant changes over time and independent associations with ARDS were determined.

Results: There were 1361 eligible patients and 237 (17.4%) met criteria for ARDS. The incidence of ARDS in non-LR exposed patients was 30.7% (75/244) vs. 14.5% (162/1117) for patients exposed to only LR products [2.61(1.90-3.60), $p<0.001$]. Mortality was not significantly different (22% for NLR vs. 19% for LR groups, $p=0.27$). The use of non-LR products and the incidence of ARDS significantly deceased over the study period (fig). Exposure to non-LR products, transfusion of $\geq$ 3 units of any blood product, fluid balance $\geq$ 2 liters within 24 to 48 hours of admission, early PIP $\geq$ 30 mmHg, blunt injury and a Chest AIS > 3 were independently associated with ARDS.



Conclusions: Leukocyte reduction may contribute to the decreasing incidence of post-traumatic ARDS in transfused patients and is justified despite variable associations with decreased mortality.

HEMOGLOBIN DROPS WITHIN MINUTES OF INJURIES AND PREDICTS NEED FOR AN INTERVENTION TO STOP HEMORRHAGE

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Introduction: Early detection of ongoing hemorrhage is essential to reduce morbidity and mortality. Frequent, repeated hemoglobin (Hgb) levels may not detect bleeding because of the time needed for plasma levels to equilibrate, or may be confounded by crystalloid-related hemodilution. Despite these concerns, we hypothesized that frequent, serial Hgb levels in the emergency department are an accurate means of identifying patients who require emergency surgical or radiological intervention to stop hemorrhage.

Methods: A retrospective cohort study of 404 consecutive patients was undertaken at an urban Level I trauma center. Patients were divided into those requiring emergency surgical or radiologic intervention to control bleeding (IG=intervention group, n=39), and those who did not (NIG=no intervention group, n= 365). All patients underwent repeated serial Hgb measurements using a point-of-care testing device starting within minutes of ED arrival. Lowest Hgb level in the first 30 minutes in the two groups were compared, and correlated with physiologic signs of hemorrhage (blood pressure, heart rate, base deficit, pH, and resuscitation volume) using Pearson's correlation coefficient.

Results: Hgb levels within the first thirty minutes were significantly lower in IG group patients (mean=12±2 vs. 13±2 gm/dl, p <.001). A decreasing Hgb level was associated with increased heart rate (r-0.12, p=.02), decreased blood pressure (r+0.29, p<.001) pH (r+0.27, p .003), and transfusion requirements during resuscitation (r-0.21, p =001), but not base deficit (r+0.04, p=.12). Hgb ? 10 gm/dl was associated with a greater than three-fold increase in need for emergency interventions to stop bleeding (Odds Ratio 3.14, 95% C.I. 1.18-8.35, p < .03), and correctly identified the need for intervention in 87% of patients.

Conclusion: Hemorrhage is associated with an early decrease in Hgb despite traditional concerns about rapidity of its change. Almost 9 out of 10 patients with a Hgb<10 gm/dl in the first 30 minutes need emergency interventions to stop the bleeding.

"NORMAL" VITAL SIGNS BELIE OCCULT HYPOPERFUSION IN GERIATRIC TRAUMA PATIENTS

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Introduction: Trauma is an increasingly common problem amongst the elderly. It has been shown that elderly trauma patients who have apparently normal vital signs may in fact be in low cardiac output states associated with increased morbidity and mortality. Base deficit (BD) and lactic acid (LA) are accepted markers of hypoperfusion and predictors of outcome in the trauma patient. Our objective is to use these measures to assess the prevalence of occult hypoperfusion (OH) in geriatric trauma patients whose vital signs by traditional standards are normal. **Methods**: The study was carried out as a retrospective review of all trauma patients age ? 65 in our trauma registry from 1997 to end 2004. Only those patients who had either an arterial blood gas sample or lactic acid level drawn on admission were included. Patients with documented head injuries were excluded from our cohort. Three patient groups were established: Normal, Occult Hypoperfusion (OH) and Shock. Criteria for inclusion in the OH group were normal vital signs (Systolic Blood Pressure (SBP) at scene and in ER > 90, Pulse at scene and in ER <120) with either an abnormal BD (< -2) or LA (> 2.2). Outcome measures included mortality, hospital length of stay and ICU length of stay. **Results**: 106 patients were included in the analysis. Groups were similar with regard to Injury Severity Score. 74% (n=78) of patients had normal vital signs at the scene and in the emergency room however 41% (n=44) of elderly trauma patients had abnormal BD or LA indicating OH. Patients with OH were more likely to have longer ICU length of stay (8.6 d. vs. 3 d. p = 0.01). OH patients were also more likely to be discharged to a nursing facility (p = 0.03). While differences in overall mortality were not statistically significant between the three groups in this study, the trend was towards increased mortality in the OH group. (Normal, 8.8%; OH 16%; Shock, 25%; p=0.08) **Conclusions**: Occult hypoperfusion is a common finding in elderly trauma patients presenting with "normal vital signs" with outcomes in these patients being different from normal patients and more like those presenting in shock.

A META-ANALYSIS OF THE CLINICAL RELEVANCE OF ANIMAL STUDIES OF RESUSCITATION VOLUME AND RATE IN THE PRESENCE OF UNCONTROLLED HEMORRHAGIC SHOCK.

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The evidence base for limited resuscitation regimens for treatment of trauma is largely based on an extensive literature of animal studies. We hypothesize that fluid resuscitation regimens used in many animal studies exceed clinical norms and thus results of such studies bias aggregate outcome results. We sought to identify all animal studies of uncontrolled hemorrhage and clinical studies of penetrating injuries with data on fluid therapy. A Medline search with selected key words identified 52 animal and 6 clinical studies. Clinical data allowed us to select a representative value for an upper limit for total volume and peak rate of infused crystalloid for initial resuscitation of a typical 80 kg trauma patient. These criteria for clinical relevance were set at a volume of 3-L (37.5 ml/kg) and rate of 100 ml/min, values higher than those reported for 80% of trauma patients. To compensate for the different volume expansion of fluid types, values for blood and colloids were 1/3 that of crystalloid, and for hypertonic fluids 1/10. A total of 171 groups from the 52 studies were used for the analysis; 90 groups received crystalloid, 32 colloid or blood, and 49 hypertonic fluids. Only 28% (49/171) of groups were judged clinically relevant or below volume criteria of (37.5 ml/kg) and 27% (46/171) below rate criteria of 100 ml/min. Only 25 groups (14.6%) met both volume and rate criteria, and 24 of these were limited resuscitation groups. Despite extensive animal research on uncontrolled hemorrhage, only a small subset of studies has resuscitation regimens that are clinically relevant to the care of most trauma patients. Purported differences may be due to over resuscitation in the “control” group. There is sparse basic science support for concluding that limited fluid resuscitation is superior or inferior. Standardization of protocols is necessary in both small and large animal models so that data may be extrapolated to clinical relevance.

SINGLE DOSE ETOMIDATE AND ADRENAL SUPPRESSION: A SYSTEMATIC REVIEW

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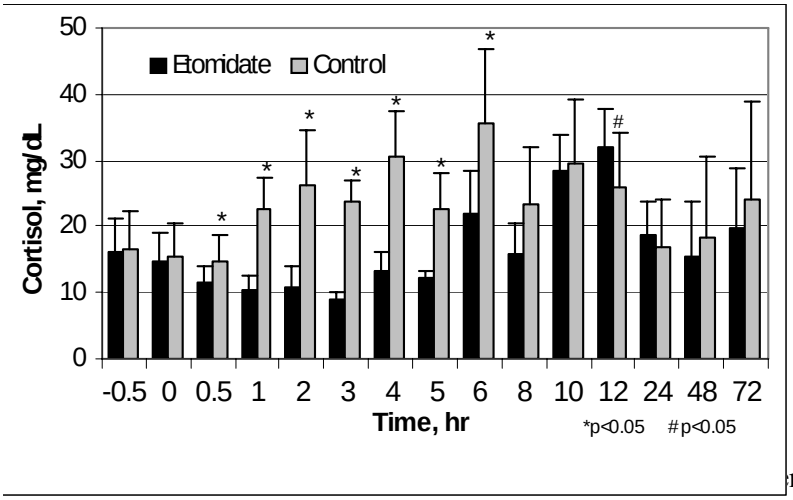
Background: Etomidate (ETO), a commonly used anesthetic induction agent, is known to inhibit the adrenocortical pathway and is suspected of causing clinical adrenal insufficiency. The duration of biochemical adrenocortical suppression after single-dose administration of ETO is not known and may affect outcomes, especially in the acute care situation. We sought to determine this duration by systematic review of existing literature. Methods: An Ovid Medline search from 1966 to 2005 was performed. Studies were included if *all* of the following criteria were met: study design was prospective; study population was elective surgery; study drugs were single dose ETO versus either thiopental or propofol; and serum cortisol was measured. Results of eligible studies were pooled to determine the time after ETO administration at which cortisol levels were not statistically different between ETO



nt's t-test. Results: Twelve articles met all of the criteria. There was a statistically significant suppression of cortisol in the ETO group between 30 minutes and 6 hours, *$p<0.05$, (Chart). At 12 hours cortisol levels reversed and were significantly greater in the ETO group, $^{\#}p<0.05$. There was no difference at 24, 48, or 72 hours. Conclusion: Cortisol levels are depressed after a single dose of ETO. It appears unlikely that there is any sustained effect after six hours. Further studies are needed to evaluate ETO use as an induction agent in emergency surgery and trauma.

COMPUTED TOMOGRAPHY IS SAFE AND COST EFFECTIVE FOR ASYMPTOMATIC PENETRATING THORACIC INJURIES

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Objective: The objective of this study is to evaluate whether an initial CT scan of the chest is comparable in efficacy to the standard procedure of serial chest x-ray (CXR) for asymptomatic penetrating thoracic injuries.

Methods: Prospective data was collected on patients at a level 1 trauma center with asymptomatic penetrating chest injuries. Those patients that met inclusion criteria obtained the current standard of care which consisted of an admission chest x-ray followed by a repeat x-ray in 6 hours. In addition, they received a standard CT scan of the chest using 5 mm cuts. Patient demographics, mechanism of injury, radiographic findings, time to CT scan, time spent in the department, and patient disposition were all recorded.

Results: Forty-two patients, ranging in age from 18 to 49 were included. Ten patients (24%) had gunshot wounds and thirty-two patients (76%) had knife stab wounds. All of the initial chest radiographs were normal. Seven of the CT scans were positive requiring admission and further management. The 35 patients with a normal CT scan had no subsequent findings on the six hour CXR. These patients were discharged with an average time in the department of 9 hours. The average time to CT scan for all patients was 19 minutes. The decrease in hospital charges for the CT scan cohort was $1,327/patient.

Discussion: Our study supports the expansion of CT scan as an initial screening tool in penetrating trauma. Eighty-three percent of our patients had a negative CT scan within 20 minutes of arrival. The remaining patients had potentially life threatening injuries rapidly identified and treated. Having a more sensitive initial diagnostic procedure should allow patients to be discharged sooner and allow trauma center staff to allocate resources more efficiently.

MULTIPLE VESSEL WALL SUBFAILURES CHARACTERIZE BIOMECHANICAL MODEL OF BLUNT AORTIC INJURY

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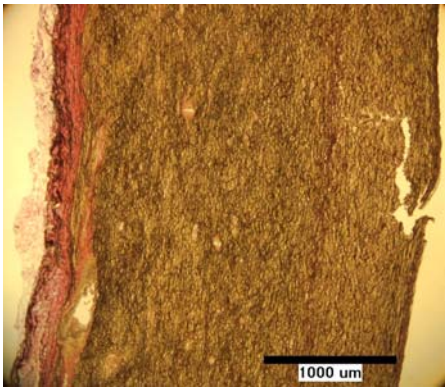
Background: This study quantified the mechanism of vessel wall injury in blunt aorta trauma. **Methods:** Forty-six fresh thoracic aorta segments were obtained from adult pigs and longitudinally distracted to failure. Temporal distraction and loading data were obtained. Vessel segments were imaged from intimal and adventitial sides using high resolution videography. In addition, two specimens were distracted until initial subfailure then released, and histology was used to characterize subfailure geometry. **Results:**



Frame-by-frame videographic analysis demonstrated intimal layer subfailures occurred prior to complete vessel wall transection (catastrophic failure) in 93% of specimens. Multiple subfailures were evident in 75% of specimens, and the adventitial layer remained intact until catastrophic failure in all cases. Initial subfailures occurred at 76% of the stress and 85% of the strain to catatstrophic failure, indicating residual strength after initial intimal subfailure that may permit acute normal physiologic function. Orientation of subfailures was perpendicular to the direction of loading. The entire intimal layer, internal elastic lamina, and a portion of the medial layer sustained lacerations. **Conclusions:** Blunt aortic injury occurs with multiple subfailures prior to catastrophic vessel failure. Residual strength remains after initial subfailure that may permit normal functioning for an undefined period. This strength appears to lie in the medial layer, suggesting a role for evaluation of the aortic wall in directing management.

THE ACCURACY OF THORACIC ULTRASOUND IN PATIENTS WITH INDWELLING CHEST TUBES IS NOT SUSTAINED OVER TIME

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PURPOSE: Ultrasound has proved to be very accurate in the diagnosis of pneumothorax in the trauma suite. It is unknown whether this accuracy is maintained over time in patients with a chest tube in place.

METHODS: Hospitalized patients with a chest tube placed to treat a traumatic pneumothorax underwent serial daily bedside surgeon-performed ultrasound by 1 of 2 experienced surgeon sonographers who were unaware of concomitant x-ray findings. Results were compared with daily chest x-rays. Data collected included size and day of placement of the chest tube, as well as the results of the serial ultrasounds and the comparative x-rays.

RESULTS: 14 patients (78% Male, mean age 34 years) sustained traumatic pneumothorax after 9 stab wounds, 3 gunshot wounds and 2 rib fractures respectively. They underwent 126 ultrasound evaluations (median: 7) and were followed between 4 and 26 days (median: 7) after injury. 82 ultrasounds were performed in hemithoraces that had no injury or chest tube in place and all 82 revealed normal pleural sliding. No pneumothoraces were noted on concomitant chest x-rays (100% Accuracy). 108 ultrasounds were performed in hemi-thoraces that had a chest tube in place. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy are listed in Table 1.

Day	n	Sensitivity	Specificity	PPV	NPV	Accuracy
1	9	100%	100%	100%	100%	100%
2	14	50.0%	75.0%	25.0%	90.0%	71.4%
3	16	50.0%	66.7%	33.3%	80.0%	62.5%
4 to 26	85	55.6%	69.0%	45.5%	76.9%	64.7%

SUMMARY: Ultrasound evaluation for pneumothorax is very accurate for the first 24 hours after insertion of a chest tube, but the accuracy, especially the positive predictive value, is not sustained over time, possibly due to the formation of intra-pleural adhesions.

FELLOWSHIP TRAINING IN EMERGENCY SURGERY: THE FOCUS ON "EDUCATION" IS LACKING

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Background: In academic medical centers, trauma and surgical critical care (SCC) fellowship programs have begun to incorporate emergency surgery (ES) as part of training for what may ultimately become the field of Acute Care Surgery. Neither ES nor Trauma is required as parts of current ACGME-approved SCC fellowships. We hypothesized that the didactic and feedback / evaluation components of postgraduate education in ES and trauma, lacking an ACGME mandate, are not present in current fellowship programs.

Methods: An electronic survey tool was used to develop a questionnaire that was distributed to program directors of 80 ACGME-accredited SCC fellowship programs. The survey examined clinical and didactic programs as well as the feedback/evaluation processes for each component of training in current fellowship programs. Fisher's Exact Test was used to evaluate questions of interest.

Results: 54 program directors responded (67.5%).

	Clinical	Didactic	Feedback/Evaluation
SCC	54	51 (94.4%)	54 (100%)
Trauma	41 (75.9%)	35 (85.4%)	36# (87.8%)
Emergency Surgery	19 (35.2%)	6* (31.6%)	6* (31.6%)

* $p < 0.01$ vs. SCC and Trauma; # $p < 0.05$ vs. SCC

Conclusions: ES has recently become a defined component of 1/3rd of current fellowship programs. The didactic and feedback/evaluation components of this portion of the fellowship are deficient. These components are routine parts of the SCC fellowship educational experience. Fellowship training in trauma surgery frequently mirrors SCC training with the majority of programs providing didactic programs and routine feedback/evaluation components. These educational deficiencies in ES training programs must be addressed as the process towards possible ACGME / ABS recognition of Acute Care Surgery moves forward.

A DIAGNOSTIC DELAY OF FIVE HOURS INCREASES THE RISK OF DEATH AFTER BLUNT HOLLOW VISCUS INJURY

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BACKGROUND: Hollow viscus injuries are uncommon after blunt trauma (BHVI) and accomplishing a timely diagnosis can be difficult. Time to operative intervention has been implicated as a risk factor for mortality, but reports are conflicting. We **HYPOTHESIZE** that a delay in diagnosis is associated with an increased risk of death after BHVI.

METHODS: Retrospective registry and chart review of all blunt trauma admissions at a level-1 trauma center from 1992 to 2005. Patients with BHVI were included. Isolated colon injuries and patients who died within 24 hours were excluded. Manual chart review was performed to determine cause of death. Associated high-risk abdominal injuries were defined as: duodenum, stomach, esophagus, or diaphragm. A scattergram was performed to identify times from admission to laparotomy that might be associated with increased mortality. Risk factors for mortality were evaluated with a logistic regression analysis.

RESULTS: 195 patients had BHVI (0.6% of all blunt admissions). Patient characteristics are as follows: mean age 35 years, 70% male, mean ISS 17, 12% presented in shock (SBP <90 mmHg), mean time from admission to laparotomy was 5.9 hrs, the small bowel was involved in 87%, and 17 (9%) died. Scattergram revealed that a delay between 5 and 8 hours might be associated with mortality and each of these whole numbers was analyzed separately. 86% of pts with a delay >5 hrs died due to abdominal-related sepsis. Variables with a p value <0.2 on univariate analysis were included in the logistic regression model:

Variable	Odds Ratio	95% CI	p Value
Age (for each yearly increment)	**1.05**	**1.02-1.08**	**0.002**
ISS (for each increment)	**1.09**	**1.04-1.14**	**<0.001**
Shock	1.97	0.51-7.65	0.33
Associated high-risk abdominal injury	3.21	0.92-11.3	0.068
Delay >5 hours before laparotomy	**3.97**	**1.12-14.11**	**0.033**

CONCLUSION: HVI injuries occurred in less than 1% of all blunt trauma admissions. Independent risk factors for mortality were age, ISS, and a delay of more than 5 hours between admission and laparotomy.

SPLENIC PSEUDOANEURSYM FOLLOWING EMBOLIZATION: OBSERVE, REEMBOLIZE, OR OPERATE

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Introduction: Main coil embolization for splenic pseudoaneurysms (PSA) is used to supplement observation after blunt splenic injury. We have noted both persistent and new PSAs following splenic main coil embolization. We review our experience to determine if these patients require additional a therapy.

Methods: A prospective study of all patients with blunt splenic injury undergoing non-operative management October 2002 – June 2005 was performed. By protocol patients with AAST splenic injury grades I –II without evidence of vascular injury undergo simple observation while the remainder underwent splenic angiography and embolization if positive for vascular injury. A follow-up ACT is performed at 48-72 hours after angiography to rule out delayed vascular injury or infarction. CT was reviewed prospectively by a senior radiologist for any signs of vascular injury or PSA.

Results: 534 patients were admitted with blunt splenic injury during this period. Those requiring immediate operation for spleen or associated reasons (34 patients), transfers, and protocol violations were excluded. 400 patients with blunt splenic injury admitted during this period completed the protocol. 43 patients required immediate surgery while 357 underwent planned non-operative management. By protocol, 167 underwent splenic angiography with 129 requiring splenic main coil embolization. 15 patients failed nonoperative management, 14 splenectomies and one splenorrhaphy giving an overall nonoperative failure rate of 4% and 9% in the angiography group. Of those embolized, 35 (27%) patients had persistent PSA and 10 (7%) patients demonstrated new PSAs on follow-up CT. Two patients required splenectomy and one splenorrhaphy giving a nonoperative failure rate of 7% and splenic salvage rate of 96%in patients with new or persistent vascular injury.

Conclusion: Follow-up ACTS with persistent or new PSAs do not mandate therapy in patients treated with main coil embolization.

MANAGEMENT OF CIVILIAN RECTAL GUNSHOT INJURIES

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Objective: To evaluate the optimal management for rectal gunshot injury.

Methods: A retrospective review of rectal gunshot injury at a Level I trauma center from Jan 1992 through May 2005. Independent variables included age, sex, injury severity score (ISS), estimated blood loss (EBL), associated injuries, fecal contamination, length of stay and use of presacral perineal drainage. Dependent variables included mortality, length of stay (LOS) and complications, including fistulae and intra-abdominal abscess. Patients were treated via four methods: (1) simple diverting colostomy without rectal repair (group A); (2) diverting colostomy and rectal repair (group B); (3) diverting colostomy and presacral drainage without repair (group C); (4) primary repair only, (group D).

Results: 101 patients were identified with rectal GSW injury, 88 (87.1%) patients had an evaluable record. 70 (79.5 %) had an identified extraperitoneal rectal injury. Groups had similar independent variables, except that group D patients had lower ISS and EBL. Deaths occurred in 2 group A and 1 group B patients, all had associated vascular injuries and significantly higher EBL. Complications occurred in 22% of patients overall with no significant difference in abscess or fistulae incidence between groups. Associated vascular injuries led to a 67% complication rate.

Group	A	B	C	D
Procedure for Rectal GSW	Colostomy only	Colostomy and primary repair	Colostomy & presacral drain	Primary repair only
N (70 total)	23	26	18	3
Fistula	2 (8.7%)	4 (15.4%)	3 (16.7%)	1 (33.3%)
Abscess	4 (17.4%)	6 (23.1%)	1 (5.6%)	0
LOS (± SD)	15.1 (± 12.3)	16.7 (± 14.8)	15.3 (± 9.9)	16.7 (± 8.6)

Conclusions: Colostomy with primary repair is not superior to diverting colostomy alone in civilian extraperitoneal rectal gunshot injury. Abandonment of presacral drains in the mid-1990s did not increase complications. Primary repair alone may a have a role in highly selected cases.

SELECTIVE NON-OPERATIVE MANAGEMENT OF LOW GRADE BLUNT PANCREATIC INJURY: ARE WE THERE YET?

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Objective: Nonoperative management (NOM) of low-grade blunt pancreatic injuries (LGBPI) diagnosed by CT abnormalities of the pancreas in the adult hemodynamically stable (HDS) patient has not been previously defined. We report our experience of patients with LGBPI at a single Level I Trauma Center. Methods: Adult HDS patients over a 5-year period with blunt pancreatic injuries with an abbreviated injury score (AIS) of 2 were identified through the hospital trauma registry. Management, complications, and outcome were reviewed. Patients who underwent initial emergency laparotomy, died in the emergency room, or had a GCS of 3 were excluded. Failure of NOM was defined by need for subsequent exploratory laparotomy or development of a pancreatic fistula, abscess, or pseudocyst. Data are reported as mean ± SEM. Results: A total of 120 patients were identified as having pancreatic injury of which 35, with pancreatic AIS of 2, were blunt HD stable patients with CT evidence of pancreatic injury. Study population consisted of 20 male and 15 females, age 32 ± 13.22, ISS 21 ± 10.08, systolic pressure 123 ± 27.06 with mean base deficit -3.78. Of these 12 (34.28%) patients had an associated intra-abdominal solid organ injury. Outcomes of NOM management of LGPI:

LGBPI (n)	Failed NOM	Pancreatic abscess	Pancreatic fistula	LOS	Mortality
35	5 (14.28%)	3 (8.57%)	1 (2.85%)	11 ± 9.71	2 (5.71%)

Of the 5 patients that failed initial NOM, 2 had missed small bowel injury, 2 had pancreatic abscess, of which 1 developed a pancreatic fistula which resolved with medical management, and 1 failed NOM for blunt liver injury. There was no death in the failed NOM group. Conclusions: Nonoperative management of LGBPI diagnosed by CT was successful in the majority of HDS patients, with low morbidity and mortality. Management algorithm for NOM of LGPI still needs to be better defined in which the role for early ductal injury detection with ERCP or MRCP be incorporated.

CONTRAST EXTRAVASATION ASSOCIATED WITH PELVIC FRACTURE: WHAT DOES IT MEAN?

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Background: Contained contrast extravasation (CE) in solid organ injury is not well correlated with the need for operative intervention, but the significance of CE in patients with pelvic fracture is unknown. **Methods:** The trauma registry at a Level I trauma center was queried for all patients with pelvic fracture from 1/1/98-5/31/05. All CT scans used multislice technology. Demographic and injury information were abstracted from the trauma registry and medical record. CT and angiography reports of all patients were reviewed. Angiograms and CTs of patients with CE were then reviewed by a radiologist. **Results:** 607 patients with a pelvic fracture and a CT were identified. 48 patients had a pelvic CE on CT scan. Patients with CE had a higher ISS (25.6 vs 18.2, $p<0.001$) and higher mortality (25 vs 7%, $p < 0.001$). 26 patients underwent angiography, with CE confirmed in 20 patients and embolization performed in 17. 7 patients without CE underwent angiography. CE was confirmed in 3 and all were embolized. A significantly higher number of patients undergoing angiography required ongoing transfusion. All patients in the no angio group with >4 units pRBC in the first 6 hours had solid organ injury. There were no other differences between the two groups.

	Angio (n=26)	**No angio (n=22)**
Systolic blood pressure (mm Hg)	124	108
pRBC first 6 hours (avg)	7.5	4.1
# with >4 units pRBC in 6 hours*	13	4
Liver or spleen injury	8	10
pRBC first 24 hours	12.2	8.8
Mortality (n,%)	7 (27)	5 (23)

* $p < 0.05$

Conclusions: CE is a marker of severe injury but does not mandate angiography. Associated injuries are common, and other sources of blood loss must be excluded. CE is not reliable enough to exclude significant vascular injury, as the therapeutic embolization rate for CE negative patients undergoing angiography is 43%.

Splenic Embolization: "The Non-Cutting Edge"

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Splenic embolization (SE) has been popularized as an adjunct to nonoperative management (NOM) of splenic injuries. SE failure rates as high as 27% have been reported especially in patients with moderate to large hemoperitoneum. We reviewed our experience with SE in managing splenic injuries from 2000-2005. **Methods.** All traumatic splenic injury patients seen at one urban Level II Trauma Center were reviewed. Patients were identified via the Trauma Registry and Interventional Radiology Logs. Medical records were reviewed for demographics, treatment strategy, complications and outcomes. In 1999, a splenic embolization protocol was established which included the use of SE in higher grade injuries without active extravasation and in those with moderate to large amounts of hemoperitoneum. Patients were initially managed by splenectomy (SPL), splenorrhaphy (SPL-SVG), NOM without interventions (OBS), or splenic embolization (SE). **Results.** There were 267 splenic trauma patients, with 34 ED deaths prior to work-up and 1 protocol violator. 84% of the SE patients had Grade III-V splenic injuries with average ISS of 22.

Initial Management	Failed → to SE (%)	→ to SPL	Death (%)	Totals N=232
SPL	0	0	8 (17)	46
SPL-svg	0	0	1 (12)	8
OBS	11 (10)	0	1 (1)	108
SE	0	5	3 (4)	70

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All deaths in the SE group were non-spleen related (2-SCI, 1-PE). 5 patients who had SE went to SPL: 2 for abdominal pain, 1 was patient request, 2 were unstable with multiple injuries. Only one spleen was actively bleeding at exploration. In the SE group 4 patients had major complications with one attributable to the spleen. Minor complications were common (63%). 11 patients who initially had OBS went on to SE with splenic salvage. A total of 81 SE were performed with 76 spleens salvaged (94%). **Conclusions**: SE can be used safely in high grade injuries with good splenic salvage rates and low major morbidity.

FEATURES OF INTRAPERITONEAL FREE AIR ON COMPUTED TOMOGRAPHY IN THE EARLY DIAGNOSIS OF BLUNT SMALL BOWEL INJURY

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Introduction: Although intraperitoneal free air (FA) on CT scans has been widely accepted as a diagnostic clue of gastrointestinal perforation, its characteristics have not been sufficiently studied in blunt small bowel injury (SBI). The purpose of this study is to clarify its practical features in the early diagnosis. **Material and Method:** A prospective study was performed of patients evaluated for blunt abdominal trauma using helical CT scans. Within 2392 consecutive injured patients transferred to our institute from Jan 1995 through Dec 2005, CT of whole abdomen were scanned on admission in 831 cases. Among them, the patients whose CT scans were obtained within 6 hours after injury were selected; and the patients with past history of laparotomy, or with other gastrointestinal perforations than SBI were excluded. In the remaining 803 cases enrolled this study, FA presence was interpreted, and when positive, its locations were dictated. Care was taken enough not to misread partial slice of thoracic cavity and of intraluminal gas, and soft tissue emphysema. All SBIs were confirmed at surgery. It was judged false-positive when the patients was managed conservatively or when no SBI was proven at surgery despite the presence of FA on the scans. FA locations were divided into perihepatic space (PH), midline under the peritoneum (ML), other lateral sites under the peritoneum (LS), intermesenteric space (IM), and others. Furthermore, whether the frequency of FA appearance depended on the SBI degree and sites was examined. **Results:** SBI was confirmed in 31 cases, and FA was detected in 18 among them. The scans demonstrated false-positive FA in 17 cases. Thus, the positive/negative predictive values were 58% / 98% with an accuracy of 92%. Among 18 true-positive cases, FA located in PH in 6 cases, ML in 7, LS in 12, IM in 13 and others in 3. In 2 cases, FA at the level of pelvis was the only FA finding. No correlation between FA presence and SBI degree / sites was detected. **Conclusion:** Although FA on the CT scans is not a definitive sign of SBI, it appears in IM most frequently. Furthermore, FA must be fully scrutinized down to the level of pelvis.

Comparing Three Methods of Interpretation of Diagnostic Peritoneal Lavage to Increase Diagnostic Accuracy for Hollow Viscus Injury

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Introduction: In addition to the traditional WBC count >500 as the diagnostic peritoneal lavage (DPL) criteria for hollow viscus injury, two other methods have been described to increase the diagnostic yield of DPL. While the traditional criteria for positive DPL prevail, we believe that these other methods have merits to be evaluated to improved accuracy for hollow viscus injury.

Material and Methods: 190 charts of abdominal trauma patients who had DPL performed between January/1999 to May/2005 at Kern Medical Center identified from the trauma registry were reviewed. A total of 136 patients were included in the study. All had complete data available and had exploratory laparotomy or a minimum of 48 hours of observation to ascertain the final outcome. DPL results were analyzed using three methods, A) positive if WBC > 500, B) positive if ratio of lavage RBC/WBC to peripheral RBC/WBC is greater than or equal to 1.0, C) positive if lavage WBC greater than or equal to RBC/150 when lavage fluid has RBC > 100,000.

Result: There were a total of 8 hollow viscus injuries in the study population. Methods A and B would have accurately identified 5 of these injuries (sensitivity 62.5%). The specificity was 90% for method A but only 37% for method B. Method C would have only identified 2 injuries (sensitivity 25%) but had specificity of 100%.

Conclusion: We conclude that 1) method B does not offer any advantage over other methods. 2) method A has the best sensitivity of all methods (62.5%) and thus the traditional method of WBC>500 is still be the most useful marker of hollow viscus injury. However, the specificity is low. 3) When combining method A (WBC > 500) with method C in presence of RBC $\geq$ 100,000, the specificity of positive DPL for hollow viscus injury becomes significantly higher.

MANAGEMENT OF ADOLESCENT BLUNT SPLENIC INJURY; UTILITY OFANGIOEMBOLIZATION

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Background: Splenic embolization (SAE) can be a used for non-operative salvage in adults. SAE utility and complication rate has not been evaluated in adolescents. We hypothesized that SAE is safe and effective in the adolescent population.

Methods: A retrospective review of all patients aged 13-17 years admitted to a Level I trauma center with blunt splenic injury from 1997-2002 was performed. We reviewed patient demographics, operative reports, admission and follow-up abdominal CT scan (ACT) results, angiographic reports, and patient outcomes.

Results: 97 adolescent patients were reviewed. Patients were predominantly male with a mean age 16 years. Predominant mechanism was motor vehicle collision. 18 underwent immediate laparotomy while 79 patients underwent planned nonoperative management (NOM). Mean splenic injury grade was 3.3, with an overall splenic salvage rate of 97%(NOM). Success rates by management and AAST splenic injury grade can be seen in Table 1. 100% splenic salvage rate was seen in the 33 patients observed. One patient with delayed vascular injury was controlled with angioembolization. Splenic salvage was 100% in the 18 patients with negative angiogram and 92% in those for planned embolization. Two patients had splenectomies, one for bleeding and one for technical inability to perform embolization, giving a 99% salvage in those actually embolized. There were no delayed splenic ruptures, symptomatic infarct, contrast reactions, or abscesses.

Table 1 Splenic Salvage by Treatment and Grade

	Grade I	Grade II	Grade III	Grade IV	Grade V
Observation (44%)	14	11	8	0	0
Angiography (23%)	1	3	12	2	0
Embolization (32%)	0	2	7	16	0

(% total population)

Conclusion: Splenic embolization may be a valuable adjunct in adolescent splenic salvage, especially in higher grade injuries or with evidence of vascular injury. Angioembolization can be performed in the majority of adolescents with acceptable complication rates.

DESTRUCTIVE COLON INJURIES AND DAMAGE CONTROL: RESTORATION OF COLON CONTINUITY AFTER THE FIRST

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Background: Management of colon injuries requiring resection during Damage Control is not well-defined. The practice of many institutions is ostomy formation which complicates the management of the "open" abdomen and later abdominal wall reconstructions. We reviewed our experience with the restoration of colon continuity after the resuscitation phase of Damage Control during a subsequent laparotomy of same admission.

Methods: An 8-year retrospective review of patients with destructive colon injuries requiring resection during the initial Damage Control operation was performed. Patients were then aggressively resuscitated in the intensive care unit. Patients returned to the operating room when their coagulopathy, acidosis, and hypothermia were corrected. Patient demographics, mechanism of injury (MOI), hospital and ICU lengths of stay (HLOS, ICU-LOS), resuscitation requirements and management of the colon injury were reviewed (anastamosis or ostomy). Data expressed as mean ($\pm$ SD), unless specified.

Results: 40 patients were identified. 34 males, 6 females, mean age 34.6 yrs (range 18-61). Mean ISS 19.1 (10.2). Mean admit GCS 10.6 (2.1). HLOS 43.2 (range 3-105 days), ICU-LOS 26.6 (range 3-87). Concomitant injuries included: liver (N=18), spleen (N=10), renal (N=4), pancreas N=3), small bowel (N=28). The mean number of laparotomies required during their hospitalization was 3.7 (range 2-10). Mean number of laparatomies to definitive colon management was 2.2 (range 1-4). 28 patients had their colon continuity restored (anastamosis), 7 colostomies, 5 ileostomies. Complications included: ARDS (N=17), pneumonia (N=18), renal failure (N=8), DVT/PE (N=7), abdominal compartment syndrome (N+3), hepatic failure (N=3).One anastamotic occurred, 18 small bowel fistulas occurred). Mortality was 17.5%.

Conclusions: Restoration of colon continuity can be safely performed after the resuscitation phase of Damage Control.

ACUTE LUNG INJURY AND MULTIPLE ORGAN DYSFUNCTION SYNDROME SECONDARY TO INTRA-ABDOMINAL HYPERTENSION AND ABDOMINAL DECOMPRESSION IN EXTENSIVELY BURNED PATIENTS

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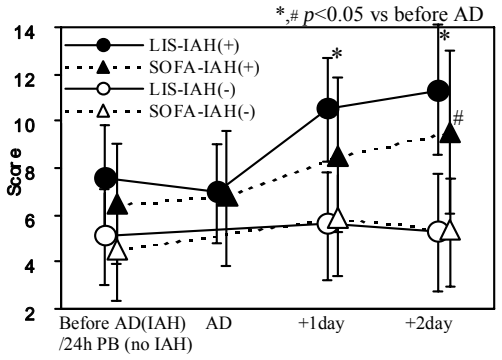
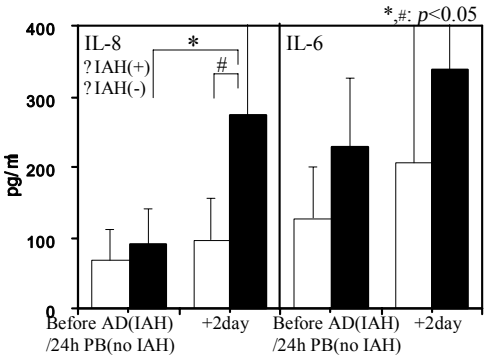
Background: Secondary abdominal compartment syndrome (ACS) is a lethal complication after resuscitation from burn shock, even after abdominal decompression (AD) is performed. This study clarified the increased susceptibility to multiple organ dysfunction syndrome (MODS) in extensively burned patients with ACS. **Methods**: Patients admitted to our burn unit between 2002 and 2005 with burns greater than or equal to 40 percent of the total body surface area without severe inhalation injury were analyzed. Hemodynamic parameters, blood gas analysis, intra-bladder pressure as intra-abdominal pressure (IAP) were recorded. Serum IL-8 and IL-6 concentrations were measured in 20 of these patients. Lung injury score (LIS) and Sequential Organ Failure Assessment (SOFA) scores were serially determined. **Results**: Fourteen of 38 patients developed intra-abdominal hypertension (IAH) in 22.9±8.9 hours postburn (PB). Hemodynamic parameters in these 14 patients, including peak IAP (46.6±11.2 to 19.8±9.9cmH_2O), peak inspiratory pressure (51.4±10.5 to 31.8±7.0 cmH_2O) and abdominal perfusion pressure (51.3±18.3 to 73.9±13.6mmHg), were improved immediately after AD. Despite AD, LIS and SOFA scores increased significantly one and 2 days later in patients with IAH. Plasma concentration of IL-8 was elevated in IAH patients. **Conclusion**: IAH induced acute lung injury and MODS with IL-8 elevation, even though AD improved hemodynamic parameters in extensively burned patients.





PROPRANOLOL DOES NOT INCREASE INFLAMMATION, SEPSIS OR INFECTIOUS EPISODES IN SEVERELY BURNED CHILDREN

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Background: Propranolol a non selective β1-2 antagonist attenuates hypermetabolism and catabolism in severely burned patients. However, recent data suggest that Propranolol impairs immune function and enhances inflammation. The purpose of the present study was to determine the effect of Propranolol administration on infection, sepsis and inflammation in severely burned pediatric patients.

Patients and Methods: A prospective, intend to treat study was performed and demographics (age, gender, burn size, and mortality), infectious episodes (colony count greater then 10^5) and sepsis (guidelines by the society of critical care medicine) were determined. Inflammatory response was determined by measuring serum cytokine expression.

Results: Two hundred and forty five patients (143 controls, 102 Propranolol) were included into the study. There were no differences between the control and Propranolol group for age, gender distribution, burn size, third degree burn and length of stay. Mortality was 5.6% in the control group and 3.9% in the Propranolol group. Twenty three patients developed infections in the control group (16%), while 18 developed infections in the Propranolol group (18%). The incidence of sepsis was 5.6% for controls and 5.8% for Propranolol. Analysis of the cytokine expression profile in 30 patients in each group revealed that Propranolol significantly decreased serum IL-6, IL-8, and IL-1β compared to controls, $p<0.05$.

Conclusion: Propranolol treatment exerts anti-inflammatory effects and does not cause increased incidence of infection and sepsis.

INTERACTIONS OF HORMONES AND AGE IN SEVERELY BURNED CHILDREN

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Introduction: The aftermath after a massive burn is determined from severe disturbances in cardiopulmonary, liver, muscle, bone and renal metabolism. Hormones are thought to be major mediators of this posttraumatic response. Aim of the present study was to determine the effect of age on serum hormone levels of pediatric burn patients over a period of two years after trauma.

Methods: Severely burned children with ≥ 40% of total body surface area (TBSA) burn were followed over two years after injury. Patients were divided into 0 to 3.9 years of age and 4 to 17.9 years of age at the time of burn. Serum hormone concentrations of human growth hormone, insulin-like growth factor-I (IGF-1), IGF binding protein-3 (IGFBP-3), insulin, cortisol, parathyroid hormone, tri-iodothyronine uptake (T3 uptake), total T4, and the free thyroxine index (FTI) were determined at hospital discharge, 6, 9, 12, 18, and 24 months after trauma. Data analysis was performed using a two way ANOVA followed by Tukey when appropriate. Significance was accepted at $p < 0.05$.

Results: Thirty patients were studied (age 0 to 3.9: n=10; age 4 to 17.9: n=20). Both groups were similar in TBSA and 3rd degree burn size and gender. Serum hormone concentrations of IGF-1 and IGFBP-3 were significantly higher patients 4 to 17.9 years old when compared to the younger age group, $p < 0.05$. Levels of total T4 were significantly higher in the younger age group whereas T3 uptake was significantly higher in the older age group, $p < 0.05$. Cortisol values were significantly higher in the younger age group, $p < 0.05$. Serum hormone concentrations of human growth hormone, insulin, parathyroid hormone, and FTI were not affected by age.

Conclusion: Age has an effect on various serum hormones in burned children for up to two years after injury. Anabolic hormones such as IGF-1 and IGFBP-3 are significantly lower in younger patients, whereas the catabolic hormone cortisol is significantly higher in this age group which could explain their increase in muscle loss.

INNATE IMMUNITY SNPS ARE ASSOCIATED WITH INCREASED RISK FOR SEVERE SEPSIS AFTER BURN INJURY

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Objective: Sepsis, organ failure and shock are common among patients with moderate to severe burn injuries. Inability of clinical factors to identify at-risk patients suggests genetic variation may influence risk for serious infection and outcome from severe injury. **Methods**: 233 patients with burns ? 15% total body surface area (TBSA) or smoke inhalation without significant non-burn related trauma (ISS ? 16), traumatic or anoxic brain injury who survived >48 hours post-admission were enrolled. Candidate single nucleotide polymorphisms (SNPs) in TLR4 (+896), CD14 (-159) TNF-α (-308), IL-1β (-31), and IL-6 (-174) were evaluated for association with increased risk for severe sepsis (sepsis plus organ dysfunction or septic shock). **Results**: After adjustment for full-thickness burn size, inhalation injury, age, ethnicity and gender, allele-carriage at TNF-α (p=0.001), CD14 (p=0.020) and IL-6 (p=0.024) were associated with increased risk of severe sepsis. There was a trend for association between TLR4 +896G and increased severe sepsis risk (p=0.063). When patients were stratified by burn size to account for the effects of overwhelming injury (full thickness TBSA cut-point = 40%TBSA), TLR4 +896G was significantly associated with increased risk for severe sepsis among patients with smaller burns (p=0.009). SNPs within IL-6 and TNF-α were significantly associated with increased severe sepsis risk among patients with smaller burns. In addition, CD14 -159C was correlated with severe sepsis risk among patients with large burns (p=0.019).

Factor	Odds Ratio	95%CI for Odds Ratio	P-value
Age	1.01	0.99-1.03	0.178
Full Thickness Burn	1.02	1.01-1.04	**0.001**
Inhalation Injury	3.25	1.50-7.04	**0.003**
Gender (Female)	1.78	0.84-3.74	0.131
TNF-α -308 A-allele	4.05	1.81-9.08	**0.001**
CD14 -159 TT	1 (ref)		0.064
CD14 -159 CT	3.07	0.98-9.65	0.055
CD14 -159 CC	3.60	1.22-10.59	**0.020**
IL-6 -174 C-allele	2.51	1.13-5.57	**0.024**
TLR4 +896 G-allele	2.54	0.95-6.77	0.063
IL-1β -31 C-allele	1.08	0.51-2.29	0.841

COMPARISON OF DERMAFILL DRESSING TO XEROFORM GAUZE IN THE TREATMENT OF SKIN GRAFT DONOR SITE WOUNDS

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INTRODUCTION: Xeroform gauze is the standard skin graft donor site dressing at many burn centers. Many products have been proposed as improvements on this basic method. Dermafill is a new biosynthetic microfibrillar cellulose film which has not been evaluated in prospective clinical trials in the United States.**METHODS:** We performed a prospective, randomized, patient controlled study comparing the rate of re-epithelialization of donor site wounds treated with Xeroform or Dermafill. From May to December 2005 eligible patients had symmetrically paired donor sites harvested by the same surgeon using a standardized technique. Wounds were assessed daily for healing, pain and inflammation. Additional data was collected on cost and outpatient scar quality and cosmetic appearance by blinded comparison of digital photographs. **RESULTS:** 19 patients completed the study. The average time to wound healing was decreased with Xeroform, 11.8 +/- 1.64 days (mean ± SD) compared to Dermafill 13.5 ± 2.34 days, ($p<0.005$). There were no differences in post operative verbal pain scores ($p=0.9$) or inflammation indices ($p=0.07$). Although scar quality was not different, the Xeroform treated sites had a better overall cosmetic appearance in 14 (74%) patients. There were no differences in cost ($0.40/each). **CONCLUSIONS:** Split thickness donor site wounds treated with Xeroform healed faster and with a better cosmetic result than those treated with Dermafill. Because of the frequency of serial excision and grafting procedures in large burns and necessity of rapid donor site healing, Xeroform gauze remains the standard donor site dressing in our Burn Unit.

SCALD BURNS FROM HOT TAP WATER: IDENTIFICATION OF HIGH RISK GROUPS AND OUTCOMES

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Background: While hot tap water is a convenience of modern society, it poses a hazard to certain groups. We sought to determine the characteristics and outcomes of patients who sustained scald burns from hot tap water.

Methods: Retrospective review of patients burned by hot tap water and treated at a regional burn center over an 8-year period. Data collected included demographics, house-hold location and mechanism of burn, suspicion of child abuse, role of known impairment in adults, treatment and outcome.

Results: From 1997-2004, 204 (8%) of 2,659 patients admitted to a regional burn unit suffered scald burns from hot tap water, as described in the table below.

	Age (yrs.)	Burn %	Bathroom	Abuse	Impaired	At Work
Child (?16) # 128 (63%)	2.5±2.5 (0.1-16)	9±9 (2-78)	81 (63%)	7 confirmed (5.5%)	_____	_____
Adult (?17) # 76 (37%)	51±19 (19-96)	9±8 (.5-36)	40 (53%)	_____	55 (72%)	15 (20%)

In children, the classic dip pattern was documented in 32 (25%), and supervision of all children was by the parent, sibling, or mother's boyfriend in 73 (57%) or others in 55 (43%). In adults, known impairments were neuropathy in 25 (33%), mental retardation in 13 (17%), epilepsy in 7 (9%), schizophrenia in 5 (7%) and other in 5 (7%). Skin grafts were required in 17 children (13%) and in 26 adults (34%) ($p<0.001$), while "take" rates varied (child: 97±16%; adult: 92±17%), (p = n.s.). 1 child (1%) and 6 adults (8%) died ($p<0.001$).

Conclusions: 1) Children and impaired adults represent populations at increased risk for scald burns from hot tap water, with most burns occurring in the bathroom. 2) Most hot tap water burns do not require grafting and heal spontaneously. 3) Adults are more likely to require skin grafting and have higher mortality than children.

GLOBAL EVACUATION OF BURN PATIENTS DOES NOT INCREASE THE INCIDENCE OF VENOUS THROMBOEMBOLIC COMPLICATIONS

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Objective: Case-control studies have suggested that air travel may be a risk factor for the development of Venous Thromboembolism (VTE). Burned multi-trauma patients from the current conflict are transported immobilized across three continents to our Burn Center with total ground and air transport time being approximately 24 hours spread over three to four days. We hypothesized global evacuation results in increased VTE rates.

Methods: We performed a retrospective chart review of 1107 patients admitted to our burn center from January 2003 to December 2005. Of these, 381 were injured soldiers air-evacuated out of theater to our Burn Center with one stop in Germany. Cases of deep venous thrombosis or pulmonary embolism during the hospitalization were recorded along with age, Injury Severity Scores (ISS), presence of inhalation injury and percent Total Body Surface Area (TBSA) burned. The incidence of VTE in air-evacuated soldiers was compared to the incidence in those admitted from the South Texas region.

Results: In the time period evaluated, no detectible differences were found in incidence of VTE between air-evacuated soldiers and those admitted to our facility from South Texas (1.31% vs 0.83%, p = ns). The air-evacuated soldiers were younger (26+/-7 vs 41+/-19, $p < 0.0001$) but had a higher incidence of inhalation injury (14.4% vs 8.0%, $p < 0.0001$) and higher ISS (10.9 +/- 13.0 vs 6.5 +/- 9.2, $p < 0.0001$). No difference in average %TBSA involvement was found (15.8+/-19.4 vs 15.5+/-18.4, p = ns). Overall, 11 of 1107 (0.99%) burned patients developed VTE.

Conclusion: Prolonged global evacuation is not associated with increased risk of VTE.

ODONTOID FRACTURES IN THE ELDERLY – DORSAL C1/C2 FUSION IS SUPERIOR TO HALO VEST IMMOBILIZATION

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Purpose: Odontoid fractures in geriatric patients occur frequently and are associated with poor outcome. The decision for operative or non-operative therapy is still discussed controversial. Recent studies confirmed that external stabilization with halo vest immobilization is still associated with high complication rates and mortality. Surgery contains a high perioperative risk due to comorbidities but previous data suggest improved outcome in this group.

Methods: To prove this hypothesis we analyzed retrospectively geriatric patients that underwent surgery for isolated unstable odontoid fractures Type II (Anderson and D´Alonzo) in our institution between 3/2003 and 3/2005. 25 patients with a median age of 81,5 (range 63-98) years were stabilized with posterior C1/2 fusion using transarticular screws (Magerl) and a modified Gallie fusion with bone graft. Postoperatively a stiff collar was applied for 12 weeks.

Results: 19 patients were reevaluated at least 3 months post trauma. All but one showed a stable fusion, all reported no or minor neck pain. The other 6 patients died during the observation period (Median 40 days post trauma). Three patients (12%) died perioperatively (cardiac or pulmonary failure, pneumonia), the others for same reasons after discharge. No wound infection occurred, one reoperation was necessary because of screw misplacement. An initial neurologic deficit improved in 2 out of 3 cases. Most patients were mobilized on day 1 after surgery. About 2/3 were discharged directly home.

Conclusions: Posterior stabilization of unstable odontoid fractures with transarticular screws and modified Gallie fusion in older patients can be performed safely, with good clinical results and few complications. However, mortality remains high (24%) but is lower than reported after Halo Vest immobilization alone (40%).

Dorsal C1/C2 Fusion is superior to Halo Vest immobilization in terms of union rate and mortality thus should be the treatment of choice in this high risk patient population.

RISK FACTORS FOR THE DEVELOPMENT OF DECUBITUS ULCERS IN TRAUMA PATIENTS

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Introduction: Decubitus ulcer (DU) is a significant complication in immobile trauma patients. The purpose of this study was to identify risk factors for DU formation for future development of prevention strategies. **Methods:** A retrospective review of a 10-year period analyzing demographics, presenting physiology, injury severity, and hospital course was conducted using NTRACS at a Level I, university trauma center. Risk factors were identified by comparing patients with DU to those without using Chi-square and ANOVA. **Results:** Of 18,784 patients, DU was identified in 208 (1.1%). DU was more common in men (69% vs. 31%, p=0.06) and patients with a blunt mechanism (96% vs. 4%, p<0.001).

Table 1. Presenting physiology and injury severity. (significance: *p<0.05)

DU	ISS	Weighted RTS	ED SBP < 90	GCS
Yes	24.9*	5.85*	11%*	10.0*
No	10.7	7.07	4.4%	13.2

Table 2. Anatomic injury location (AIS) and spinal cord injury (SCI) incidence.

DU	Head	Face	Chest	Abdomen	Extremity	Soft Tissue	SCI
Yes	3.96*	1.76	3.34*	2.66	2.74*	1.00	7.7%*
No	3.07	1.74	2.89	2.58	2.43	1.05	0.9%

Table 3. Hospital course and mortality.

DU	ICU Days	Vent Days	Hospital Days	Death
Yes	17.8*	20.6*	37.1*	12.5%*
No	1.5	2.3	6.2	5.8%

Mean body mass index was significantly higher in DU patients (31 vs. 27, p<0.001). In isolated injuries, as AIS increased from 1 to 5, DU incidence increased from 0 to 4.7% for head and 3 to 17.6% for chest. No direct relationship was identified for isolated extremity injuries. **Conclusion:** As expected, risk factors for DU in injured patients include injury severity and unstable physiology. Moreover, discrete injuries predisposing to immobility and a prolonged hospital course, have a greater rate of DU. Early recognition of risk factors will allow for the development of targeted prevention measures to reduce the incidence of this complication.

A PAIN IN THE NECK: ANALYSIS OF PEDIATRIC CERVICAL SPINE INJURIES

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Cervical spine injuries in children are relatively uncommon, yet lead to a tremendous burden on resources to diagnose and treat, with significant long term issues. We reviewed our experience with this injury to describe the presentation and outcomes in children.
Methods: The trauma registry was searched for ICD9 codes consistent with cervical spine injury in children 18 years and under over 5 years. The patient's medical records were then reviewed to ascertain the injuries and obtain demographic as well as mechanism, imaging, costs, management, and associated injury data.
Results: Of the 3959 patients admitted to the children's hospital with trauma (2382 blunt), there were 75 patients with cervical spine injuries (1.9%). Average age was 12.4 (1-17) years, and 54% were male, with 64% Caucasian. Average ISS was 21.8, and there were 11 deaths. The most common mechanism of injury was MVC (73%) followed by ATV accidents (6%). Seatbelts were reliably used in only 16%. We noted that C1 and C2 fractures (35%) were the most common injuries, with C6 fractures (17.9%) the next common. Spinal cord injuries were noted in 18.7%, with 2/3 having severe residual impairment. Non operative treatment was noted in ¾ of the survivors, with halo placement the most common procedure. Associated injuries were dominated by TBI (33%), long bone fractures (28%) and facial fractures (17.3%). Associated vertebral injuries were noted in 15%. CT scans were done in 76%, MRI in 21%, plain XR in 89% cases. The average LOS was 11.2 days, and average costs about $ 72,000. Follow up with any specialist was noted for an average of 5.4 months, with 12% having continued disability.
Conclusion: This is the largest single institution series of cervical spine injuries in children. A majority of patients did not have associated SC injury, with mostly good outcomes. The hospital cost of these injuries is significant and does not take in to account the negative studies performed in other patients. TBI and facial fractures are the most common associated injuries and suspicion for cervical spine injuries should be higher for them.